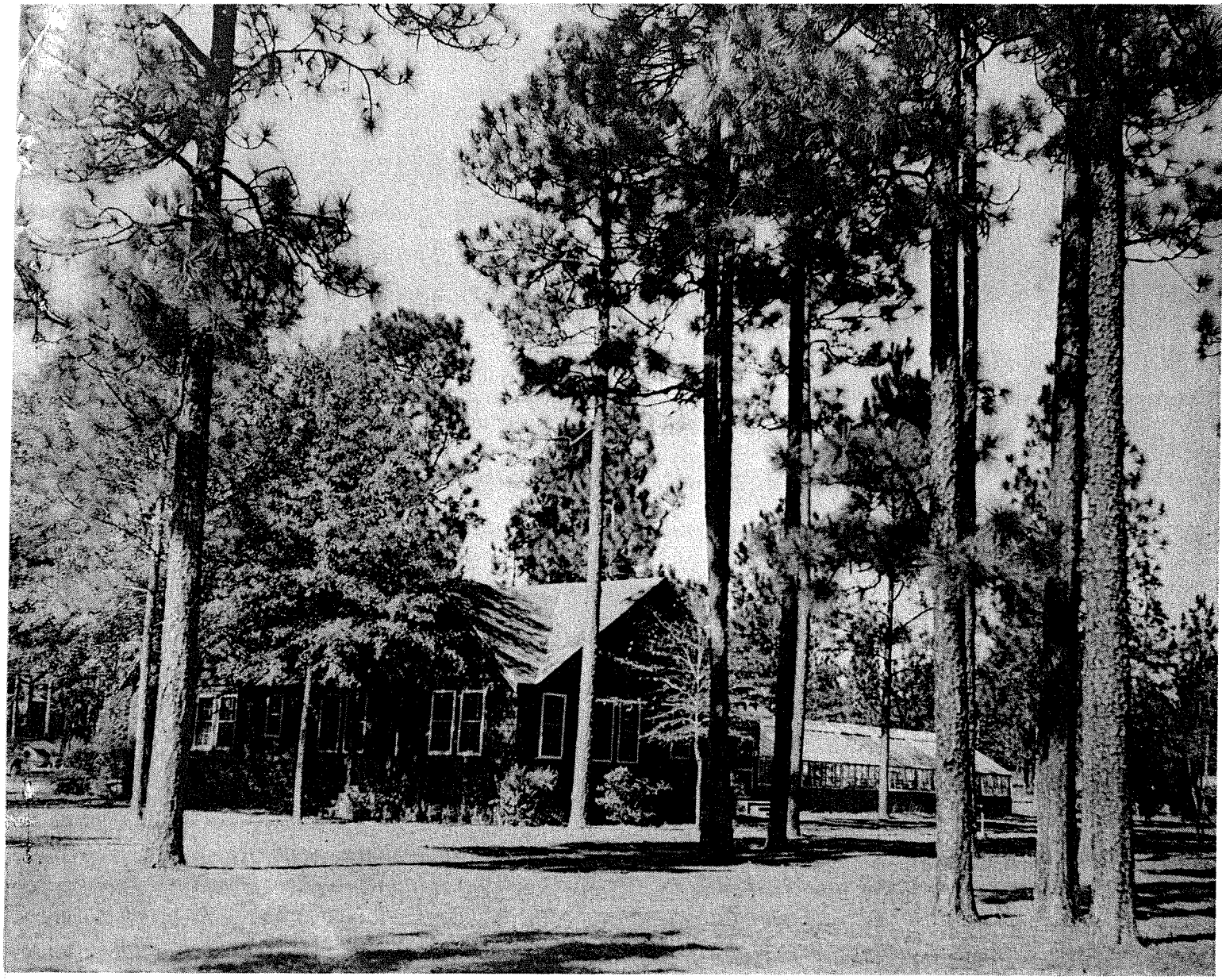

Cover photo: Laboratory and greenhouse of the Southern Institute of Forest Genetics.

1954 ANNUAL REPORT

Southern Forest Experiment Station

Philip A. Briegleb, Director

FOREST SERVICE

U. S. DEPT. OF AGRICULTURE

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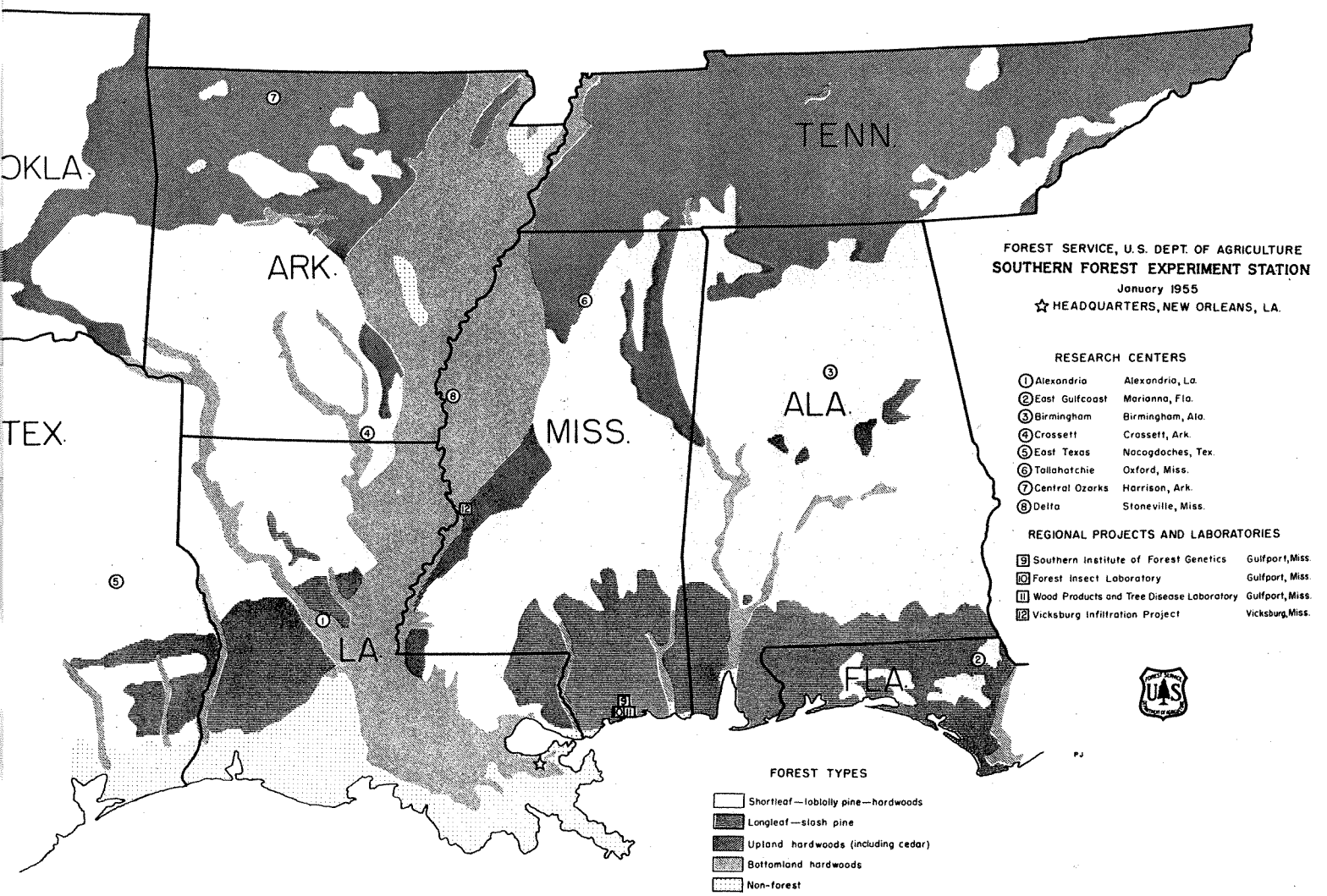
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FOREST SERVICE, U.S. DEPT. OF AGRICULTURE
SOUTHERN FOREST EXPERIMENT STATION
January 1955
☆ HEADQUARTERS, NEW ORLEANS, LA.
RESEARCH CENTERS
1 Alexandria — Alexandria, La.
2 East Gulfcoast — Marianna, Fla.
3 Birmingham — Birmingham, Ala.
4 Crossett — Crossett, Ark.
5 East Texas — Nacogdoches, Tex.
6 Tallahatchie — Oxford, Miss.
7 Central Ozarks — Harrison, Ark.
8 Delta — Stoneville, Miss.
REGIONAL PROJECTS AND LABORATORIES
9 Southern Institute of Forest Genetics — Gulfport, Miss.
10 Forest Insect Laboratory — Gulfport, Miss.
11 Wood Products and Tree Disease Laboratory — Gulfport, Miss.
12 Vicksburg Infiltration Project — Vicksburg, Miss.
FOREST TYPES
Shortleaf—loblolly pine—hardwoods
Longleaf—slash pine
Upland hardwoods (including cedar)
Bottomland hardwoods
Non-forest

1954 ANNUAL REPORT, SOUTHERN FOREST EXPERIMENT STATION

1954 completed the fiftieth year of operation of the U. S. Forest Service and the thirty-fourth year for the Southern Forest Experiment Station. The half century just past has brought dramatic changes in the forests of the South and to the people and industries dependent upon them.

In 1905 the forests of the mid-South were chiefly virgin stands just beginning to be exploited on a large scale. By 1930 most of this splendid timber was gone, and many of the lumbermen had closed their mills or moved West. The world was suffering the worst depression in history, and the South was soon to be dubbed the Nation's No. 1 economic problem.

During the 1920's and 30's, southern forestry met, and passed, a crisis. Not all of the lumbermen moved out. Some remained behind, to wrestle with the new problems of building a permanent forest and a permanent forest industry in the South. The U. S. Forest Service helped by fostering State and private forestry organizations, by awakening the public to the cost of wildfire, by applying practical management in the National Forests, and by establishing the Southern Forest Experiment Station to provide needed technical knowledge.

Our forests are changing.--Now, in 1955, the faith of these stay-at-home pioneers has been justified by an improved relationship between forest regrowth and depletion. This is confirmed by the findings of the second Forest Survey. With the completion last year (in cooperation with State and private agencies) of field work in Louisiana, the new Survey has reinventoried about 89 percent of the area cruised by the epochal First Survey of 1932-36. To date, Mississippi, most of Arkansas, Alabama, and now Louisiana have been resurveyed 1/, while an initial inventory has been made of Tennessee and the Arkansas Ozarks--a total of 91 million acres of forest.

1/ Field work has been resumed in east Texas, which was partially resurveyed in 1953. Eastern Oklahoma, also surveyed in 1932-36, will be reinventoried in 1956.

At the time of the First Survey the virgin timber in most of these regions had only recently been harvested. The new inventory finds the timber economy of these States based on second-growth stands. And in gradually widening areas over the South--most notably perhaps in Louisiana--the Survey is showing a favorable balance of growth over cut.

Forest industries are expanding. --This balance was achieved partly by the development of second-growth stands, partly by the reduction in cut that followed the dwindling of the old-growth. Now it seems likely that production is again going to rise to meet the demands of a fast-growing population. The lumber industry experienced some slowing of markets in the fore part of 1954, but it enjoyed a strengthening demand for its products by the year's end. And in east Texas construction was in progress on what will be by far the largest sawmill in the South. This is in contrast to the trend toward smaller sawmills that has prevailed for several decades.

Major expansions of established pulp mills are under way. In addition, two new pulp mills started operation in the mid-South during the year, and plans for two more new plants were announced recently. Still more pulp mills and other wood converting plants are seeking new industrial sites that have back of them a permanent raw material supply.

Today's forester in the mid-South faces two problems. He must cut enough timber to fill the immediate requirements of an expanding industry, and he must build up growing stock if the forest is to supply the very much greater wood-using industry anticipated in the next few decades.

Research to ensure a timber supply. --The better to ensure that essential timber supply, Congress last year provided for the establishment, at Gulfport, Mississippi, of the Southern Institute of Forest Genetics. A part of the Southern Forest Experiment Station, the Institute replaces the former Gulfcoast Branch, and in fact is continuing important Branch studies in management and regeneration. It will also do applied research in tree selection and breeding for the immediately surrounding territory. Its main function, however, will be to investigate fundamental forest genetics problems and serve as a demonstration area and source of information for forest genetics research and application for the entire South. The Institute will cooperate closely with Forest Service Research Centers and other agencies--Federal, State, and industrial--that have genetics research programs under way.

Improved utilization helps. --This transition from old-growth to second-growth timber, coupled with rising labor costs and the competition from wood substitutes, has forced many problems upon the South's wood-

using industries. If wood is to keep or expand its markets, the skills and initiative of industry must be combined with the findings of research. The Station's Forest Utilization Service tries to facilitate this union, both by getting new research developments into practice and by relaying industry's problems to such research organizations as the U. S. Forest Products Laboratory.

Since the war, the Utilization Service has been instrumental in increasing the use of sawmill waste for pulp chips, in promoting the use of wood preservatives and construction methods that will counteract decay and insect damage, and in improving methods of seasoning lumber. It has also been trouble-shooter on innumerable and varied wood-utilization problems of a specific nature. Long undermanned and swamped with work, the Utilization Service last year was able to add another man to its staff.

Insect and disease control will reduce losses. --1954 was the first year in which the Station had full responsibility, within the area delineated on the map facing page 1, for Federal research on the diseases and insects attacking living trees and wood products. Field work on insects is centered at the Forest Insect Laboratory at Gulfport. An entomologist is also assigned to the East Texas Research Center at Nacogdoches, Texas (working largely on pine bark beetles). Another entomologist, stationed at the Delta Research Center at Stoneville, Mississippi, started in 1954 to study the various hardwood boring insects causing tremendous degrade of timber annually. The need for insect research at some of the other field research centers is becoming increasingly urgent.

The protection of forest products from stain and decay is studied at the Wood Products and Tree Disease Laboratory at Gulfport. Research leading to designs for decay-resistant buildings has nearly been completed, and future work will deal largely with control of decay in primary forest products like pulpwood and sawlogs.

Work on the diseases of southern pines, particularly the fusiform rust of slash and loblolly and the brown spot needle blight of longleaf, is also centered at Gulfport. Establishment of the Southern Institute of Forest Genetics will permit a fresh approach to protection from diseases, and, to some extent, from insects: the selection and breeding of resistant strains. Hardwood disease research, chiefly on sweetgum blight and various heartrots, is under way at the Delta Research Center.

Hardwood research advanced. --Forest management research expanded during the year. New work in hardwoods was made possible by an increase in appropriations and by cooperative contributions from private

industry. After thorough study, a program was formulated for expanded research on upland hardwoods in Alabama and Mississippi. Bottomland hardwood research in the Mississippi Delta also received new funds which made possible an expanded program. A fire specialist has been added to the staff of the Division of Forest Management. He will coordinate fire research at the various research centers and will conduct some studies of his own.

Water problems are increasing.--Water, especially in its useful aspects, is of increasing concern in the South. The Vicksburg Infiltration Project has succeeded in developing equations for predicting soil moisture content in situations where such content cannot be measured directly. The work is being done for the U. S. Army Corps of Engineers, but the basic knowledge that is being accumulated is proving useful to forestry. The major soils of continental United States are under study, and the Army plans to extend the work to the tropics.

In July, representatives of the Forest Service, the Soil Conservation Service, and the Agricultural Research Service met and formed an interagency committee to review the urgent research needs in some of the erosion problems of watershed management, especially with regard to the Yazoo-Little Tallahatchie Flood Prevention Project in north Mississippi. In response to this committee's report the Station is concentrating its watershed management research on the most troublesome of current flood prevention problems.

Wildlife research begun.--The Division of Range Management Research last year began to explore methods of improving the forest as a habitat for deer and other wildlife. Southern land management is intensifying so rapidly that game, like timber, must be planned for. One of the most urgent problems is the effect that various forest management practices, including timber stand improvement, have on production of both game and timber. The research proposed will be in cooperation with State agencies and the U.S. Fish and Wildlife Service.

Most of the matters just discussed are attempts to adjust the Station's program to the needs of the future. Meanwhile, as the following pages indicate, established studies are bearing fruit.

FOREST MANAGEMENT

Genetics

Southern Institute of Forest Genetics Established

A major event in forest research at the Southern Station in 1954 was the transformation of the former Gulfcoast Research Center into the Southern Institute of Forest Genetics, centered at the Harrison Experimental Forest about twenty miles north of Gulfport, Mississippi.

The purpose of the Institute is threefold:

1. To focus the attack of a strong staff with highly specialized training, adequate laboratory and field facilities, and assured continuity of effort upon fundamental problems of forest genetics. The results should measurably strengthen the applied tree-improvement research of the Southern and Southeastern Forest Experiment Station Research Centers and of other agencies in the South.

2. To conduct an aggressive program of applied tree improvement with the species and under the climatic and other conditions characteristic of the locality in which the Institute is situated.

3. To serve as a convenient repository of information on forest genetics research and its application, to which inquiries and problems can be referred and at which visitors can get an overall picture of theoretical and applied genetics, particularly of the southern pines.

The Institute was activated on August 29. The staff is being gradually expanded and the physical plant improved. The program will not be crystallized until after extensive consultation with other organizations active in the field.

The Texas Forest Service loaned an expert forest geneticist to assist in early planning of the Institute's work. Informal preliminary cooperation with the Biophysics Laboratory at Tulane University was

arranged to study effects of irradiation of pine seed to induce cytogenetic changes. The Botany Department of Newcomb College is also cooperating on a study of the anatomy and phenology of flower primordia formation, pollination, and fertilization in the southern pines.

Southwide Pine Seed Source Study Expanded

The number of plots planted in the Southwide Pine Seed Source Study, under the chairmanship of the Southern Station, was increased from 1,528 to 1,788. Among the additions was most of a new series of longleaf pine test plantations not covered in last year's Annual Report.

Thirty-six plots remain to be installed. Stock for these plots was grown during 1954 in seven cooperating nurseries, from seed obtained and distributed by the Southern Station. When distributed and planted during the current season, this stock will bring the total cooperative planting in the study to approximately 220,000 trees in sixteen States.

The 1953 and 1954 droughts and other causes have destroyed or severely injured some of the individual test plantations, especially in Texas, Oklahoma, Arkansas, and the Carolinas. Longleaf Series 2 (designed to compare geographic races from deep sands with those from heavier soils) and the three shortleaf series have been particularly hard hit, though in no case rendered wholly ineffective. Several cooperators have suggested supplementing or replacing the original plantations, and the possibilities of doing so are being explored.

Although complete re-examinations of all the 1,528 seed-source plots established in 1953 will not be made again until 1955, observations of some test plantations during 1954 have shown striking variations among different geographic races. Loblolly pine in particular has exhibited conspicuous racial differences in growth rate, resistance to drought, and percentage of rust infection.

Crossett Loblolly Race Studied at Various Localities

The Crossett Research Center, despite drought losses, succeeded in starting a study of geographic races of loblolly pine. It sent Crossett loblolly seed varying distances from Crossett and had the resulting stock tested by cooperators against stock from seed collected near the distant planting sites. The purpose of this study is to define the territory within which it may be advisable to use either run-of-the-mill Crossett seed or seed of desirable special selections later developed at the Research Center. The study will be expanded at the first opportunity.

Loblolly Pine Seed Source Studied in Cooperation with TVA

Three research centers made five-year remeasurements of loblolly pine from seed from eight geographic sources. The plantings were made in cooperation with the Tennessee Valley Authority. Results are shown in table 1. Except for the relatively poor average height of the north Georgia stock at the Birmingham Research Center, and of north Alabama stock at the Tallahatchie Center (at Oxford, Mississippi), both height and survival rather consistently decreased with increased distance of seed source from planting site. The stock from the two most northeasterly sources was clearly unsuitable for north Arkansas, central Alabama, and northern Mississippi.

Table 1. --Heights and survivals of loblolly pine from seed of eight different geographic sources five years after planting

Geographic source of seed	Average height at--							Survival at--						
	Birmingham, Alabama		Oxford, Mississippi		Harrison, Arkansas		All three locations	Birmingham, Alabama		Oxford, Mississippi		Harrison, Arkansas		All three locations
	Ft.	Rank	Ft.	Rank	Ft.	Mean Rank	Rank	Percent	Rank	Percent	Rank	Percent	Rank	Mean Rank
Southeast Tennessee	12.2	2	6.0	2	10.6	3	1	94	3	44	2	94	2	2
North Georgia	10.7	7	8.2	1	11.5	1	2	94	4	46	1	98	1	1
North Alabama	12.6	1	4.8	7	11.1	2	3	94	2	31	4	79	3	3
East Mississippi	11.8	5	6.0	3	9.9	5	4	83	5	27	6	75	4	5
Northeast Mississippi	11.2	6	5.0	5	10.2	4	5	77	6	38	3	75	5	4
South Alabama	12.1	3	4.9	6	9.4	6	6	98	1	29	5	69	6	6
Virginia	12.0	4	5.1	4	9.3	7	7	71	8	6	8	59	7	8
Maryland	10.2	8	4.1	8	8.4	8	8	75	7	17	7	50	8	7

Bogalusa Loblolly Pine Seed-Source Study Remeasured

With the cooperation of the Gaylord Container Corporation, the Station made the 28-year remeasurement of its original loblolly seed-source plantation at Bogalusa, Louisiana. Preliminary indications are that stock from local Louisiana seed has maintained its superiority in rust resistance over Georgia stock, and its superiority in height, diameter, and volume growth over Georgia, Texas, and Arkansas stock.

The form class (ratio of diameter inside bark at top of first log to diameter outside bark at breast height) of the Louisiana trees is consistently better than that of the Texas, Georgia, and Arkansas trees of the same diameter class. In other words, a Texas, Georgia, or Arkansas tree not only takes longer than a local Louisiana tree to reach a given diameter at Bogalusa, but when it has reached that diameter it still contains less wood than the Louisiana tree.

Native Willow Outgrows Danish Hybrid in Arkansas and Mississippi

Danish hybrid willow clones which had been planted at the Crossett and Delta Research Centers in 1953 suffered much worse mortality during the 1954 droughts than did native willows planted as checks, and the surviving Danish willows grew far less well than the checks. Two Danish clones were retested at the Delta Center in 1954; one failed completely and the other, although about 66 percent survived, developed mostly into sprawling bushes with multiple stems. The poor performance is interpreted as the result of moving the Danish hybrids to an environment far different from that to which their parents were adapted.

Crossett Carries Out Selection and Breeding Program

The Crossett Research Center outplanted stock from the seed-screening and "plus" nursery-seedling phases of its loblolly pine selection studies. It has additional stock in the nursery from these phases, and from wind-pollinated 1953 seed from mature "plus" trees, for planting in 1955. Several new mature "plus" trees were found in 1954, but, because of the scanty cone crop, wind-pollinated seed was obtainable from only three.

The loblolly stock planted at Crossett included some from seeds less than 8/64, 8/64 to 10/64, 10/64 to 12/64, and more than 12/64 inch broad. In August 1953 the seedlings from these seed lots averaged 2.8, 3.6, 4.2, and 4.8 inches high, respectively. At the end of the nursery growing season they averaged 5.2, 6.9, 7.9, and 8.0 inches high. In contrast, seed similarly screened in 1954 to produce stock for 1955 planting yielded seedlings that differed little in height after the middle of the nursery growing season.

The Crossett nursery-selected seedlings of loblolly pine were drawn from the beds of three cooperating nurseries. They were in sets of three, with an average and a stunted seedling, for checks, taken from the immediate vicinity of each "plus" seedling. Average heights of the "plus" and the two types of check seedlings planted this year were 13.2,

7.2, and 4.0 inches, respectively. Similar nursery selections have been made for planting in 1955, in one case from a nursery in which the seed was graded to size before sowing.

Selection Among Delta Cottonwoods

At the Delta Research Center at Stoneville, Mississippi, progeny tests were established with cuttings from about 100 "plus" cottonwood seedlings selected from a natural stand on a sandbar, and from five "plus" cottonwoods of greater age. During the first year's growth, cuttings from one of the five older trees proved to be consistently superior in diameter growth (fig. 1).

Selection at the Southern Institute of Forest Genetics

The Southern Institute's first selection studies began with a re-examination, jointly with the Gaylord Container Corporation, of twelve acres of 30-year-old experimental plantations of slash, longleaf, and loblolly pines at Bogalusa, Louisiana. The re-examination is being made to salvage all data on survival and growth before the stands are opened up to induce flowering of selected breeding trees. The age of these experimental plantations, which were among the first established in the South, makes them especially valuable for breeding. The known geographic sources of the seed used in their establishment is a further advantage. Most important of all, however, trees of outstanding form, growth rate, and resistance to or recovery from insect attack and diseases were noted as potential breeding trees when the stands were two to six years old.

Figure 1.--One-year-old cottonwoods grown in the nursery at the Delta Research Center from cuttings taken from a select tree of a natural stand. The tallest sapling is 12.3 feet in height and 1.6 inches in d.b.h.

During the current re-examination, Gaylord foresters are indicating the phenotypes considered superior for pulpwood production. Institute personnel will make independent selection of phenotypes superior for integrated utilization, and will make final selections of breeding trees after comparing their own and Gaylord's choices with the list of outstanding juvenile phenotypes.

1954 Breeding Activities

In the spring of 1954 the Station, at its Alexandria and Crossett Research Centers; at the Southern Institute of Forest Genetics; and at Many, Louisiana, in cooperation with A. J. Hodges Industries; control-pollinated pine flowers in more than 1,400 bags. Table 2 summarizes the 48 distinct inter- and intraspecies crosses tried and the number of different localities at which each was attempted. The seeds from such of these crosses as succeed will mature in the fall of 1955.

The year's work in controlled pollination resulted in new photographs useful in distinguishing female pine flowers in the receptive stage from those which have developed past the possibility of effective pollination (figures 2 and 3) and in the development of an inexpensive

Figure 2. --Female flowers of longleaf pine at optimum stage for pollination. Note wide spaces between scales.

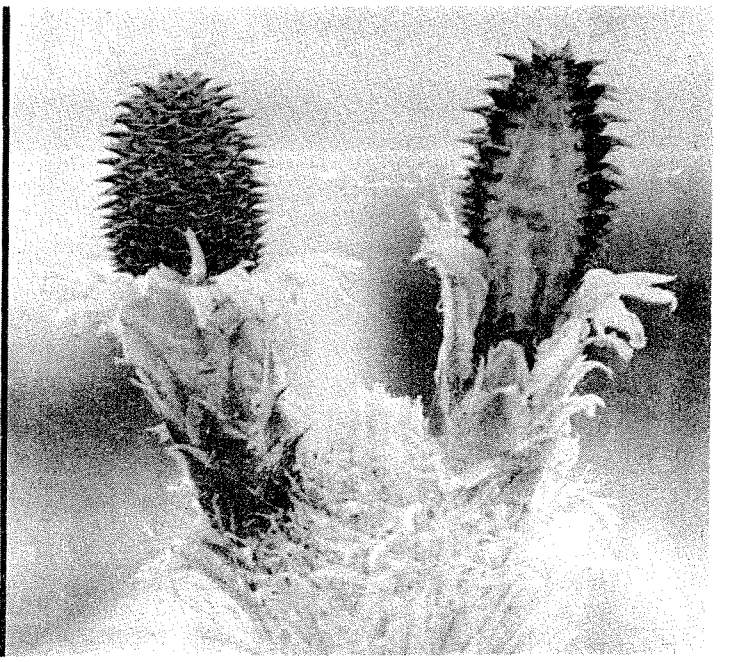


Figure 3. --Flowers no longer receptive to pollen. Ends of scales have thickened and press together so that pollen cannot enter.

Table 2. --Number of localities at which controlled pollinations of southern pines were made by the Southern Forest Experiment Station in 1954

Male parents 1/	Female parents 2/								
	Longleaf pine			Slash pine	Loblolly pine	Shortleaf pine			Sonderegger pine
	Ordinary	Black-seeded	Brown-spot resistant			Ordinary	Fine-branched	Coarse-branched	
Self	4	1	1	2	4	2	1	1	2
Longleaf pine (*P. palustris*)									
Ordinary	1	...	1	2	4	1	...	...	3
Black-seeded	...	1	...	...	...	...	...	...	...
Slash pine (*P. elliottii*)	4	...	...	1	3	3	1	1	...
Loblolly pine (*P. taeda*)									
Ordinary	4	...	...	2	...	2	...	...	3
"Plus" tree	...	...	...	...	1	...	...	...	...
Shortleaf pine (*P. echinata*)									
Ordinary	1	...	...	1	1	...	...	...	...
Fine-branched	...	...	...	...	...	...	1	1	...
Coarse-branched	...	...	...	...	...	...	1	1	...
Sonderegger pine (*P. sondereggeri*)	1	...	...	...	2	...	...	...	1
Spruce pine (*P. glabra*)	1	...	...	1	1	1	...	...	...
P. engelmannii ("*P. apacheca*")	2	...	...	...	...	...	...	...	...
P. montezumae	2	...	...	...	...	...	...	...	...
F1 *P. echinata* x *P. elliottii*	1	...	...	...	...	2	...	...	2
F1 *P. echinata* x *P. taeda*	...	...	...	...	...	...	...	1	...

1/ In all cases unbagged flowers, to be wind-pollinated, were left as checks.
2/ Run-of-the-woods trees unless otherwise noted. In these exploratory studies of interspecific and self-compatibility and general characteristics of hybrid progeny, parent trees have been chosen for accessibility, abundance of flowers, and dates of flowering, rather than for superior form.

and convenient pollinizer. The pollinizer, with several other devices developed by the Station or called to its attention by cooperators, was described in Occasional Paper 136, which is listed among the year's publications.

Exploratory Studies of Cytogenetic Techniques

The Institute and the Alexandria and Crossett Research Centers sowed loblolly pine seed subjected to six intensities of X-rays. The Crossett Center also sowed four to eight lots apiece of loblolly seed subjected to various treatments known to affect germ plasm--colchicine, neutron bombardment, and ultrasonic vibration, all at various levels or dosages. Preliminary data were obtained on lethal and injurious levels of treatment, and stock was produced for later observation of possible cytogenetic effects.

Progeny Testing

The Southern Institute of Forest Genetics shared with the Alexandria, Crossett, and East Gulfcoast Centers and six outside cooperators 406 hybrid seedlings, 290 seedlings from selected trees, and 593 seedlings to serve as checks--all from controlled or open pollination in 1951. The Crossett Research Center outplanted additional hybrids and checks from its own nursery, partly in progeny-testing areas and partly in transplant beds. Although many of the planted seedlings succumbed to the severe droughts of 1954, enough survived to permit interesting contrasts between different hybrids and between hybrids of seedlings of selected trees and their checks at several points in the Station territory (fig. 4).

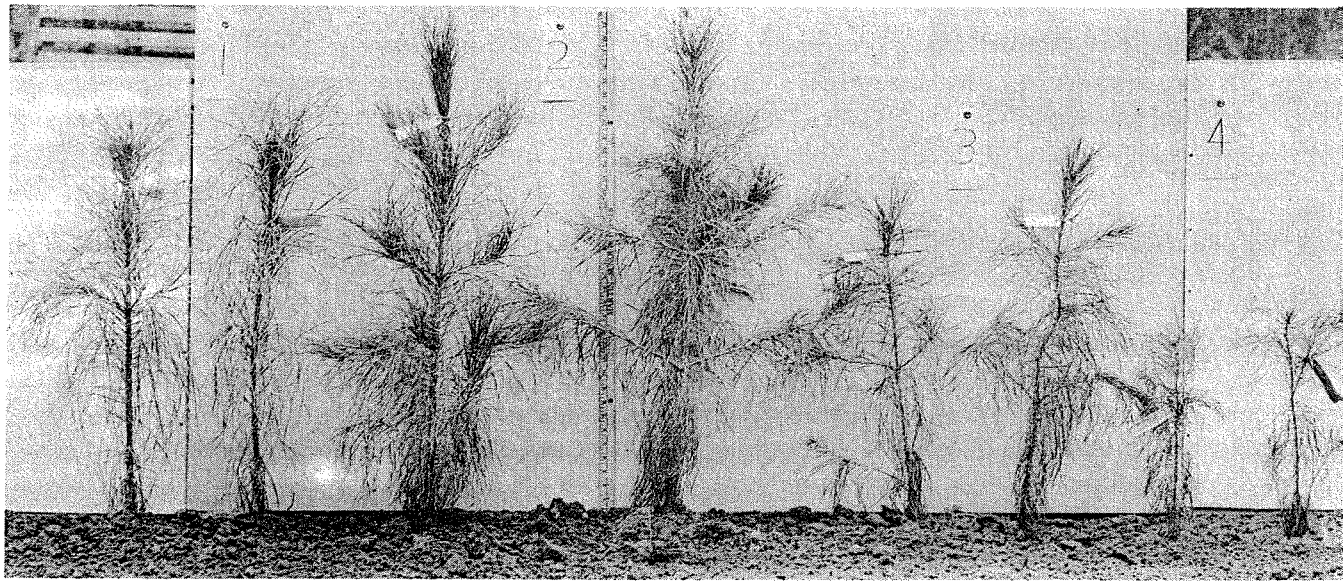


Figure 4. --Pairs of reciprocal crosses of slash and shortleaf pines and of the parent species, all 1-1 transplants grown at the Crossett Research Center from 1-0 seedlings less than six inches high in February 1954. All pollination took place at the Alexandria Research Center in 1951. 1, Slash pine from wind-pollinated seed. 2, From seed from the same female parent tree as 1, control-pollinated with shortleaf pollen from trees at Placerville, California. 3, From seed from a shortleaf pine near Alexandria, Louisiana, control-pollinated with slash pine pollen from Mississippi. 4, Shortleaf pine from wind-pollinated seed from the same female parent as 3. The hybrids were made in an attempt to get a tree less susceptible to rust infection and ice damage than slash pine, and faster growing and more tip-moth resistant than shortleaf. The good growth of 2 suggests that hybrid vigor may also have been obtained.

Regeneration

"Planting the Southern Pines" Published

The greatest single contribution of the Station to forest regeneration is the publication in 1954 of Agriculture Monograph No. 18, "Planting the Southern Pines," by Philip C. Wakeley.

The monograph summarizes the technical knowledge that is now available on this subject. The information has been drawn from many sources, but the bulk is from studies conducted by the Southern Forest Experiment Station since 1922 and from records of Region 8, U. S. Forest Service. In the monograph a number of the findings from these studies are published for the first time. Most of the studies and observations cited from other sources have not previously been evaluated in one publication.

Successive steps in planting are discussed in the order in which they are usually carried out. Thus policy decisions, seed, nursery practice, field planting, and protection and early care of plantations are taken up successively, in five separate chapters.

South Arkansas and South Mississippi Nurseries Study Chelates, Fall Sowing, Shading

Preliminary tests were made of the effect of certain chemicals in reducing chlorosis at the Crossett experimental nursery in south Arkansas. The new chelate--Chel 330 FE--seems less toxic than Sequesterene NaFe. The latter damaged several minor southern pines and some exotics though neither compound affected loblolly or shortleaf adversely. Both aided recovery from chlorosis, but the degree of effectiveness was not measured.

At the same experimental nursery, fall sowing materially aided germination and survival of species of Abies, Picea, Chamaecyparis, Tsuga, and Ginko. It had little effect on Pinus, Cupressus, Cedrus, or Taxodium.

Shade during the hot summer months appeared to be necessary at Crossett for species of Abies, Picea, Chamaecyparis, Tsuga, Ginko, Libocedrus, Cunninghamia, Cryptomeria, and Sequoia. It was unnecessary for most species of Pinus and Taxodium.

In a nursery in southern Mississippi, partial shade retarded growth of longleaf pine seedlings. The seedlings were grown under lath frames that gave controlled light intensities of 100, 50, and 25 percent. Seedlings were fertilized, watered, and kept free from brown spot and vegetative competition. At the end of the first growing season, root-collar diameters of unshaded seedlings averaged 0.59 inch, while seedlings grown under light intensities of 50 and 25 percent had root-collar diameters of 0.46 and 0.28 inch respectively.

Low Nursery Seedbed Density Improves Vigor of Longleaf Seedlings

The density at which longleaf seedlings grew in the nursery significantly affected their first-year survival and vigor when outplanted near Alexandria, Louisiana. Both survival and vigor were highest for seedlings from low-density nursery beds.

Average survivals were 77, 71, and 58 percent for seedlings grown at densities of 10, 20, and 30 per square foot respectively. Seedlings grown at 10 per square foot had about 3 times as many vigorous first-year survivors, and those grown at 20 per square foot had twice as many, as those grown at 30 per square foot.

On some seedlings foliage was clipped to retard transpiration. Both unclipped and clipped seedlings showed about the same survival trends with seedbed density, but clipping lowered survival by an average of 9 percent and reduced the number of vigorous seedlings by about 25 percent. No explanation has been found for the lower survival of clipped seedlings; in fact it is contrary to more extensive earlier tests. It does suggest, however, that on some sites or under certain conditions, clipping the foliage may lower survival.

A prescribed burn during the first winter after planting killed 11 percent of the seedlings produced in the nursery at 30 per square foot, 2 percent of those grown at 20 per square foot, and none of those from beds at the lower density of 10 per square foot.

Growth Regulators Help Some Hardwood Cuttings to Root

Various hormones failed to stimulate rooting of yellow-poplar cuttings at Oxford, Mississippi. Only one out of 1,650 cuttings rooted, and it was an untreated check. Seven different phenological dates for securing and planting the cuttings were tested, along with several different immersion periods in several concentrations of three well-known auxins (indolebutyric, indoleacetic, and naphthaleneacetic acid).

At Stoneville, Mississippi, a similar failure to root was noted with sweetgum, whether auxin-treated or untreated. However, a 24-hour soak in indolebutyric acid appeared to help cottonwood, green ash, and sycamore cuttings. The other two auxins were also beneficial, except that napthaleneacetic acid appeared to reduce sycamore rooting. Of course, all these species root fairly well even when untreated. About 25 percent of some Nuttall oak rooted, but the auxins appeared to have little effect, beneficial or otherwise, on the process.

Growth Regulators Hurt Some Pine Nursery Seedlings, No Benefit to Others

An effort was made at the Harrison Experimental Forest in south Mississippi to study the effect of growth regulator sprayed on foliage of slash and longleaf pine seedlings in nursery beds. The hope was that prolonging dormancy prior to outplanting might result in less shock, better hardening-off, and earlier growth after outplanting.

Maleic hydrazide (MH) delayed the start of spring growth of outplanted slash pine for four weeks, but had no effect on longleaf. The dates of application (September, October, November, December) did not affect the results in slash pine, but increasing the concentration of the MH spray from 1/16 to 1/2 of 1 percent caused a gradual reduction in slash pine survival from 60 percent to 28 percent. With longleaf, on the other hand, the change in concentration did not affect survival much, but a December spray resulted in only 8 percent survival as compared with 27 percent for seedlings sprayed in earlier months.

Pine Planting Stock in West Florida Little Affected by Nursery Soil Type

Satisfactory planting stock, at least for the west Florida sandhills, apparently can be produced in a wide variety of nursery soils.

Slash pine seedlings were grown in four different soils at the two Florida Forest Service nurseries at Munson and Olustee. Soils varied from deep sand to a loam with a semi-plastic yellow-brown clay subsoil. Sandhill outplanting tests for two successive years have revealed no significant differences in survival attributable to these particular nursery soil differences.

Dalapon and Methyl Bromide Show Promise as Herbicides in South Arkansas and South Mississippi

In south Mississippi, pretreatment of seeding areas to reduce grass and weed competition prior to sowing longleaf pine gave preliminary results on effective application rates of various chemicals.

The herbicides (table 3) were applied in July on an area which had been burned the previous winter. Plots were one-fifth milacre (1/5000-acre) in size. All chemicals except pentachlorophenol and HCA (hexachloroacetone) were applied in mixture with water; these two were used in No. 2 diesel oil. Diesel oil was also applied alone. Plots were examined in October and the apparent top-kill of grass and weeds was noted. Check plots at the time of examination showed an average density of 36

percent of grass cover and 17 percent of weed cover. The table shows the dosages needed to reduce grass and weed density to no more than 30 percent of untreated density (each chemical was tested at 3 dosages).

Table 3. --Herbicide applications needed to reduce grass and weed competition, in longleaf areas in south Mississippi

Chemical	Rate of application per acre--	
	To reduce grass to 30 percent of check	To reduce weeds to 30 percent of check
	Pounds	Pounds
Sodium TCA	80	(2/)
Dalapon	20	40
Sta-Chlor	200	200
Polybor-chlorate	400 1/	400
Sodium chlorate	200	400
Sodium borate	1,200	600
Ammate	80	(2/)
Pentachlorophenol	80	80
HCA	20 1/	20
#2 diesel oil alone	300 gals.	1,200 gals.

1/ No lower rates tested.
2/ 160 pounds was the highest rate used but was not effective.

At Crossett, Arkansas, several chemicals were tested for weed control in the experimental nursery. Dowfume MC-2 (methyl bromide under pressure) gave the best results. Allyl alcohol and fermate were less satisfactory.

Grass Competition Hurts Longleaf Seedlings in Louisiana and Mississippi

Near Alexandria, Louisiana, two levels of grass competition control--annual hoeing, in May, of grass in an 18-inch circle around seedlings; and annual clipping, in May, of all grass in an 18-inch circle around seedlings--did not significantly increase the second-year survival of planted longleaf over unhoed and unclipped seedlings. Survival averaged 59, 55, and 52 percent for hoed, clipped, and untreated spots respectively. In addition, spraying with Bordeaux mixture in May and November (to control brown spot) was compared with no spraying; of

course, it was not expected that brown spot would seriously affect survival in two years' time. However, spraying, hoeing, and clipping effectively increased seedling growth. After the second year, plots on which the grass had been clipped had nearly twice as many pine seedlings in vigorous condition as untreated plots. This was true on both sprayed and unsprayed plots (table 4). Hoeing further boosted the proportion of vigorous trees on plots where brown spot was held in check, but the incidence of brown-spot infection was very high on seedlings hoed but not sprayed.

Table 4.--Surviving longleaf 2 years after planting in central Louisiana

Treatment	Seedlings starting height growth	Seedlings about to start height growth	Both classes
	- - - - -	Percent	- - - - -
Grass hoed			
Sprayed	12	67	79
Not sprayed	2	36	38
Grass clipped			
Sprayed	3	57	60
Not sprayed	1	31	32
Check			
Sprayed	1	32	33
Not sprayed	0	17	17

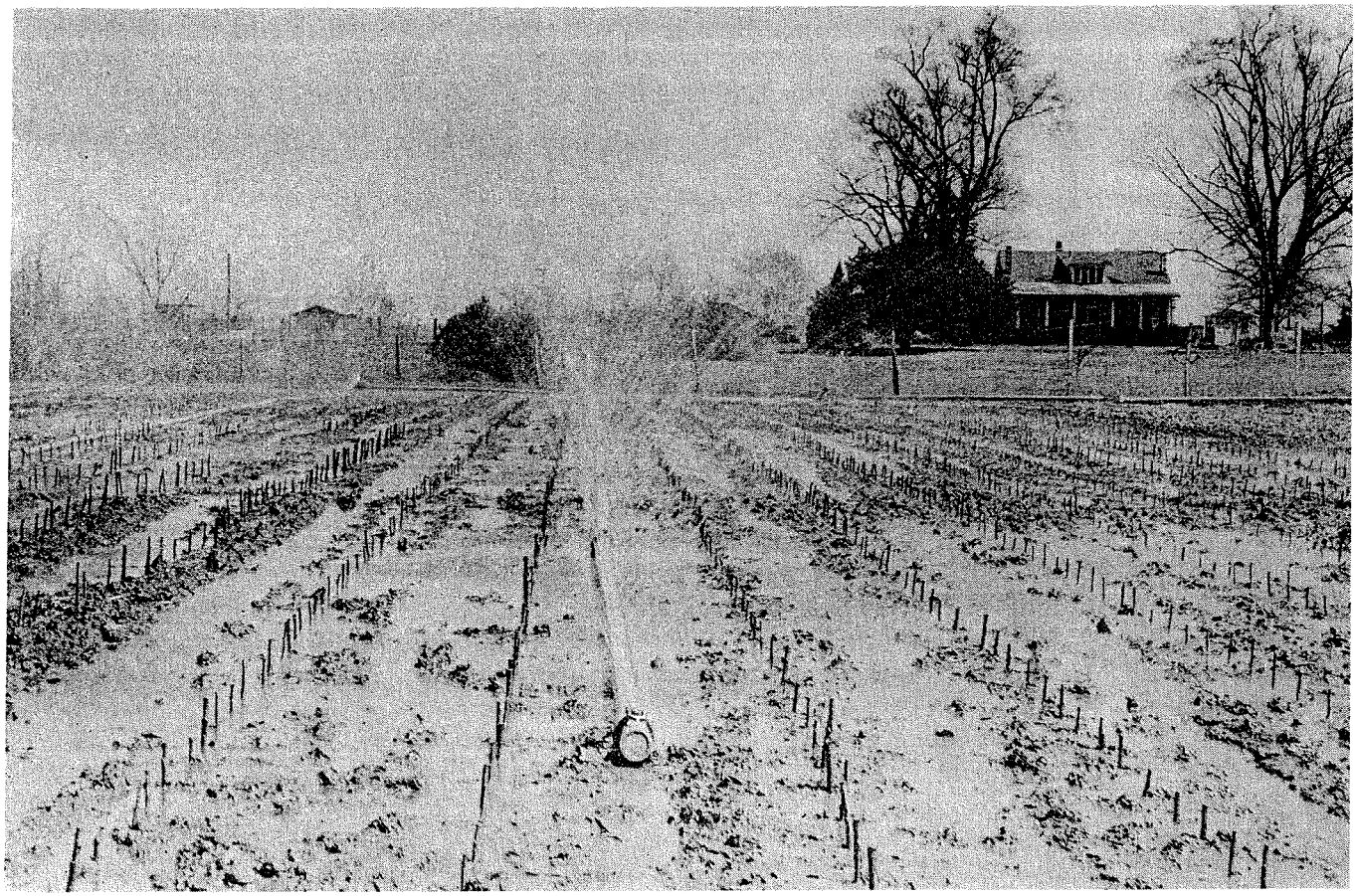
Another study of direct-seeded longleaf pine seed-spots in south Mississippi substantiated the importance of removing grass competition. Two years after grass vegetation around the seed-spot had been killed with allyl alcohol, the average groundline diameter of longleaf seedlings was 0.38 inch as compared with 0.32 inch on untreated spots. The growth difference was reduced by the fact that brown spot affected 46 percent of the seedlings on treated spots (causing diminished growth) as opposed to only 10 percent on the untreated plots. Where brown spot was controlled by spray, groundline diameters were 0.43 inch where allyl alcohol had been used and only 0.28 inch where no allyl alcohol was used.

Still another study confirmed the observation that root competition rather than light competition is the major factor in the depressant effect of grass on longleaf seedling growth. Frequent clipping of surrounding grass benefited the seedlings much less than its complete extermination. However, where clipped grass was piled on top of a seedling already competing with grass, a severe setback to survival and growth was noted.

Site Preparation for a Cottonwood Cutting Nursery

A subsoil plow mounted on a D4 Caterpillar tractor has proven quite useful in laying out rows and preparing the soil in the cottonwood cutting nursery at Stoneville, Mississippi. The chisels, which were set for a 15-inch depth to correspond with planting practice, loosened the ground sufficiently to permit planting without the use of a planting rod. Three rows were prepared at a time. The subsoiling facilitated irrigation throughout the growing season (fig. 5). A subsoil plow of this

Figure 5.--Irrigating the Delta Research Center's cottonwood cutting nursery during a dry spell in March, before the start of the growing season. Three irrigations nullified drouth effects and produced trees 10 feet tall and 3/4 inch in d. b. h. by the end of their first growing season.



sort could also be used in the establishment of an ordinary cottonwood plantation. For this purpose, the plow could be set to make 2 rows at a time, 6 feet apart.

Site Preparation and TSI Aid Loblolly Plantations in East Texas

During a summer of severe drouth, survival of newly planted loblolly pine in east Texas depended on release from competing vegetation.

Seedlings were planted in December 1953 and February 1954 in two separate areas--one a sod-covered field and the other a pine-hardwood stand of sawlog size. Two or more treatments were compared on each site. The spring and summer were extremely dry and hot. Total precipitation from March through September was 58 percent below normal; the deficit was 14.8 inches. From May 12 to July 28 only 0.9 inch of rain fell--in 6 small showers. Between June 20 and September 20, maximum temperatures exceeded 100° F. on 57 days and 95° F. on 81 days; only on 2 days were maxima below 90° F.

Pine survival in November 1954 was 10 percent on the untreated sod-covered field and 24 percent on the scalped spots. In the wooded area, survival was 18 percent on untreated plots and 60 percent on some plots that had been prescribe-burned during the summer 1-1/2 years prior to planting. Where hardwoods had been deadened by chemical means just before the pines were planted, survival was 75 percent. An additional treatment where all pines were cut and all hardwoods deadened was also tested, but the freshly cut pine stumps attracted pales weevils to such an extent that survival fell below that of the untreated wooded area.

Prescribed Burning No Help to North Alabama Underplanting

In northern Alabama, prescribed burning before underplanting low-grade upland hardwood stands with loblolly pine has not improved either the survival or the first-year growth of the seedlings. Releasing the seedlings immediately after they were planted did help.

In a study being conducted on the Bankhead National Forest, near Grayson, cutting all undesirable hardwoods over 5 feet tall resulted in a first-year survival of 91 percent, while pine survival on unreleased areas averaged 52 percent. First-year height was somewhat greater where release was applied (16 vs. 12 inches), but the advantages of release will likely become more apparent from the second year on. A light prescribed burn made just prior to planting did not

measurably benefit seedlings on either released or non-released areas. These results paralled those in a similar test made near Birmingham.

Underplanted Conifers and Hardwoods Thrive in North Mississippi

In north Mississippi the third-year results of four consecutive years of underplanting ridge hardwoods with six conifers show that immediate release from overstory competition generally improves survival and more than doubles early height growth of planted seedlings (table 5).

Table 5.--Average survival and height of three-year-old conifers underplanted during four consecutive years in north Mississippi

Species	Survival		Height	
	Released	Unreleased	Released	Unreleased
	- - Percent - -		- - Feet - -	
Loblolly pine	62	51	4.4	1.8
Shortleaf pine	58	54	2.7	1.1
Virginia pine	57	62	3.6	1.6
Slash pine	26	24	3.2	1.4
Longleaf pine	17	13	.2	.0
Eastern redcedar	67	72	1.4	.6
All species	48	46	...	...

Loblolly pine continues to grow faster than the other conifers and to date appears to be the best species for restocking depleted timber stands on dry ridges in north Mississippi.

Release is also essential for the best growth of underplanted hardwoods in north Mississippi, particularly such relatively intolerant species as yellow-poplar and black locust. In the four years since they were planted on moist sites, released yellow-poplars have grown four times as fast as non-released ones. On similar sites, black locust has grown seven times as fast when released as it did when not released. The growth of white ash, black walnut, and white oak has also been greatly improved by release, except that black walnut planted on a dry site made poor growth with or without release.

Release doubled the survival of black locust and yellow-poplar but did not improve the survival of white ash, black walnut, or white oak.

Drastic Site Preparation Improves Survival of Planted Pines in West Florida Sandhills

Removing the roots and stems of scrub oaks and wiregrass from west Florida sandhills increases the first-year survival of planted pines. Partial removal of this competition is of very little benefit (fig. 6).

Competition can be eliminated by bulldozing, root raking, or plowing open furrows. In two years of planting the first-year survival of slash pine has averaged 85 percent where these site-preparation methods were used. Partial elimination of competition by such methods as disking, brush chopping, burning, or chemically killing all woody vegetation but leaving wiregrass has resulted in an average survival of only 66 percent. This is not much better than the survival of 62 percent obtained with no site preparation at all. Both longleaf and sand pine have reacted to the various treatments in a similar manner, though their survival was generally lower than that of slash pine.

There is evidence that these differences in survival are related to the effect the various treatments have on soil moisture. In a series of measurements made on the fourteenth day of periods without rainfall, it was found that unprepared sites had only 48 percent as much moisture as sites from which the competing vegetation had been almost completely eliminated. Partial elimination only boosted the moisture up to 57 percent of that found on the competition-free sites. Differences in the amount of moisture available for pine growth (total moisture less moisture percent at the lower limit of the wilting range) were even more pronounced. At the critical depths (3-9 inches) there was about 13 times as much usable moisture on the competition-free areas as on unprepared areas and over twice as much as on the partially prepared sites.

There was no evidence that first-year pine survival on prepared planting sites was correlated with surface soil temperatures. Although temperature of the surface soil often exceeded 140° F. (the generally accepted lethal range is 130-135° F.), the bark of planted seedlings apparently provides ample insulation.

Other Planting Tests in the Sandhills

Slash, loblolly, and shortleaf pines showed higher survival than longleaf or Monterey pine when planted on a bare sandhill site in west

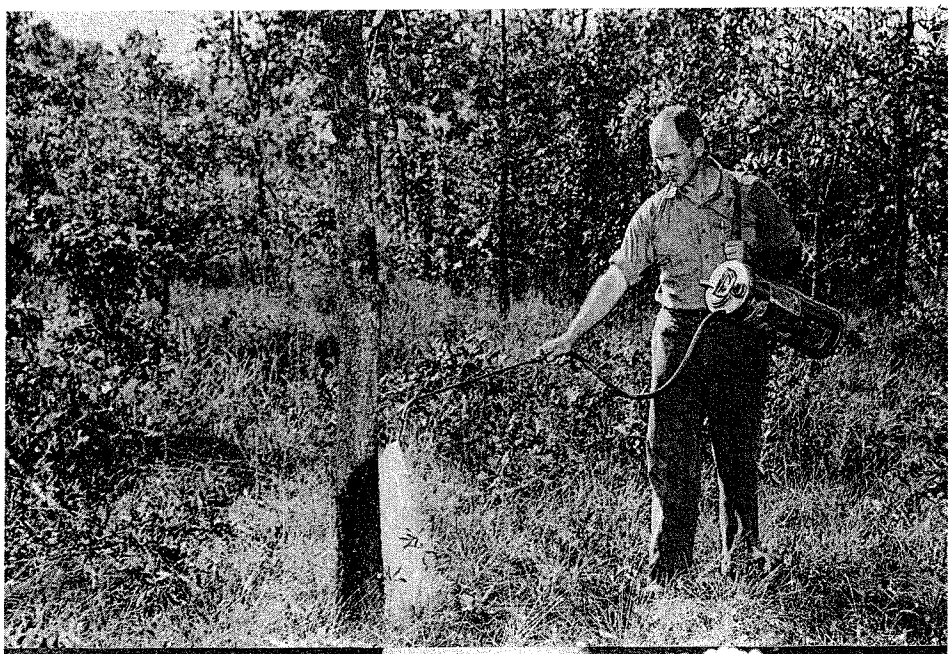
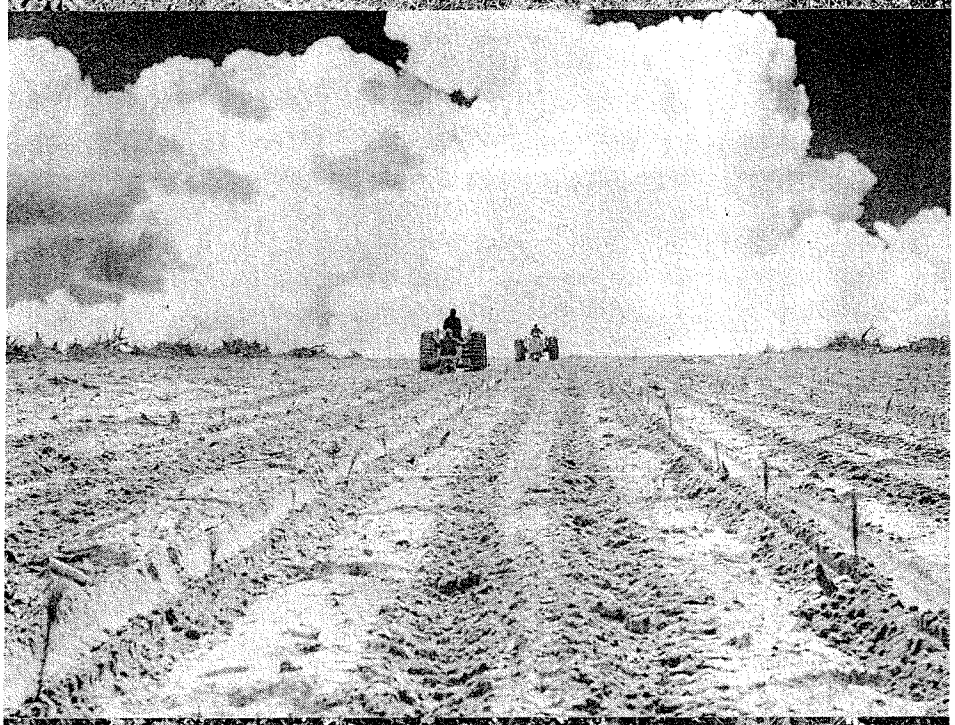


Figure 6.--Partial elimination of competition--such as killing the scrub oaks by basal spraying--does not seem to help the survival and growth of pines planted in west Florida's sandhills.



Complete removal of root competition has secured much better results.

The important factor seems to be the effect of the treatments on soil moisture. Electrical instruments make it possible to follow the daily moisture trends associated with various site treatments.

Florida. First-year survivals were 94 percent for slash, 95 percent for loblolly, 91 percent for shortleaf, 45 percent for longleaf, and 48 percent for Monterey pine. The same experiment also compared survivals of bar-planted and machine-planted pines. Differences were negligible for all species but longleaf, where survival was 55 percent for hand-planted seedlings and 34 percent for those set by machine.

In another test, it was found that the "bar-slit" method of hand-planting gave almost as good survival as the "open-hole" method. This is in line with results elsewhere. Survival being nearly equal, the bar-slit method is preferred since it is much cheaper than open-hole planting.

In still another west Florida test, slash pines survived better when planted in mid-winter (early January) than in late November or late February (table 6).

Table 6. --Slash pine survival by season of planting

Date of planting	First-year survival
	Percent
November 14-19, 1952	54
November 17, 1953	59
January 5, 1953	81
January 5, 1954	94
February 20, 1953	58
February 23, 1954	65

In South Mississippi and Louisiana, Newly Planted Longleaf Suffers More from Drouth Than Do Slash and Loblolly

Plantings were made during 1953-54 for the test of the adaptability of the southern pines to various planting sites in south Mississippi and southeastern Louisiana. Twenty-five test plantations, each containing three 1/12-acre replications of slash, loblolly, and longleaf pine, were established. Seven of the plantings also contain shortleaf pine.

During this exceptionally dry first year, site affected the survival of longleaf more than that of slash or loblolly pine. There was not a large difference between slash and loblolly survival on any plot (table 7). Where shortleaf was included, it survived as well as slash pine.

The Gulfcoast Forest Research Advisory Committee is cooperating with the Southern Institute of Forest Genetics (formerly the Gulfcoast Branch) in this extensive study.

Table 7. --Difference in first-year survival of several pine species planted on different sites in southern Mississippi and southeastern Louisiana

Type of site	Species			
	Loblolly	Slash	Longleaf	Average
	- - - - - Percent - - - - -			
Dry	63	70	30	54
Medium	73	74	42	63
Wet	84	85	66	78
Average	73	76	46	65

Slash Pine Summer Growth Ceases Earlier on Poorly Drained Site Than on Better Drained Site

Trends in height growth of slash pine were similar on four sites throughout two growing seasons in south Mississippi. Growth was rapid through April and May; gradually tapered off during June, July, and August; and ceased by October. On the best upland sites fairly rapid growth continued through June and July.

When observations began early in 1953, the trees averaged 18.4, 13.4, 5.1, and 5.2 feet in total height on old field uplands, cut-over upland, cut-over swamp, and wet meadow sites, respectively. The plantation on the cut-over swamp was three years old and those on the other sites were six years old.

The two upland soils are deep fine sandy loams. The swamp site has a muck soil and the wet meadow a deep sandy soil that is low in organic matter. Both wet sites have standing surface water in rainy periods and free subsoil water yearlong.

Growth on the two upland sites was very much alike in amount and trend throughout both growing seasons. In the cut-over swamp, growth was only two-thirds that on uplands though the trends were similar. On the wet meadow, growth was only one-fourth that on uplands and was about completed by July. The pines on the swamp muck soil appear thrifty. Those on the wet meadow are stunted, having had sparse foliage since their second growing season in the field.

Promising Bird-Repellents Found in Longleaf Direct Seeding in Central Louisiana

Anthraquinone, a chemical used in photographic processing, may prove to be a good bird-repellent. When Morkit, a commercial product containing anthraquinone, was applied to longleaf pine seed sown during late fall in central Louisiana, an initial catch of 4,500 seedlings per acre was obtained. An equal number of untreated seed (approximately three pounds per acre) sowed on a similar one-year-old grass rough gave a catch of 195 seedlings.

Encouraging as these results are, they are far from final. In another direct-seeding test, for example, anthraquinone-treated seed gave a catch of 3,780 seedlings per acre. This was 2,000 more than the catch obtained with untreated seed, but the test was too small to evaluate the element of luck. A third test of these and other bird repellents on spring-sown seed was destroyed by rodents.

Hiding longleaf seed under 1/4-inch of loose soil may also be a way to reduce losses to birds. When longleaf seed sown on disked strips in the fall was covered with a layer of loose soil, an initial catch of 1,650 seedlings was obtained. This is three times the catch obtained when the seed was not covered. The soil concealed the germinating seeds for the first 20 days and when they emerged, the seed coats were shed in about 10 to 15 days. The merit of this technique will, of course, depend on finding an economical method of covering the seeds without burying them more than 1/4-inch deep.

Hand-Seeding Longleaf Pine is Cheap in Central Louisiana

In the fall of 1953, 440 acres of open land in central Louisiana were sown to longleaf pine at an average cost of $8.83 per acre. The area sown had a light grass rough which had been produced for $0.20 per acre by prescribed burning one year before sowing. Seeding rate was slightly over three pounds per acre. The seed itself represented a large proportion of the cost. It was purchased at $2.00 per pound, and cleaning and dewinging added another $0.05 per pound. Total seed cost per acre was $6.27. Sowing, with a hand-operated "cyclone" grass seeder, required $0.47 per acre. A bird patrol during the germination period cost $1.89 per acre.

In good years, seed can be purchased at about $1.00 per pound, so that the above costs could be reduced by at least $3.00 per acre. On the other hand, where disking is necessary the cost per acre would be increased by about $2.75.

Direct-Seeding Slash Pine in Central Louisiana

Fall sowing of unstratified seed on a light rough gave the best initial catch in an exploratory test with slash pine near Alexandria, Louisiana. The test compared spring and fall sowing, stratified and unstratified seed, disked seedbed versus a one-year grass rough, and combinations of these. In general, fall sowing was superior to spring sowing, and unstratified seed was better than seed that had been cold-stratified for 27 days prior to sowing. In most cases the catch was better on a light rough than on the disked strips.

It should be noted that there are several "howevers" associated with the above results. Birds and rodents are usually less troublesome in the fall and if the young seedlings can survive the winter, fall is the best time to sow. In this test, fall-germinated seedlings came through the mild winter with only minor losses. However, a bad winter might have changed the picture. The best initial catch of seedlings was on the light rough. However, severe grass competition during the second or subsequent years may wipe out this initial advantage. Finally, the untreated seed generally gave the best catch. However, treated seed germinated more rapidly and this would have been a distinct advantage in reducing exposure in years when bird damage is bad. More experience will be needed before generalization is safe.

Silviculture

Longleaf Pine: Why and How to Grow it.

Longleaf pine is a tree of many uses and high value. It has long been and continues to be in great demand for sawlogs, poles, piling, pulpwood, and naval stores. Such a variety of products and good markets helps make it a profitable tree to grow.

Longleaf is more resistant than other southern pines to fire, insects, and such diseases as littleleaf and fusiform rust. In fact, where land cannot be continuously protected from fire, longleaf may be the only species that has a chance of success. Another important advantage is its ability to grow better than most other species on the drier sites, including deep sandy soils. But regardless of site, where longleaf pine is already growing on the land, either as trees bearing seeds or as young growth, it will pay the owner to protect and manage this longleaf as a crop.

Natural conditions and management practices in the longleaf type are generally more favorable for cattle grazing than in other southern pine types. Under certain circumstances, this makes it possible to use the forest land to produce both timber and cattle.

Some objections to growing longleaf pine include the damage that can be done by hogs and the brown spot needle disease, the difficulty of establishing new stands, and longleaf's slow early growth and resultant late returns. Proper management can partly overcome many of these objections. On the better soils of the Coastal Plain, however, loblolly pine or slash pine may survive and grow better, and should probably be preferred to longleaf.

Once a forester or landowner has made up his mind, USDA Farmers' Bulletin 2061 tells him "How to Grow Longleaf Pine." This booklet was another 1954 contribution of Southern Station personnel toward making research findings available to all.

Pine Stocking Excellent on Selection Management Study in Southern Arkansas

At Crossett, Arkansas, in a 960-acre study area that has been managed under the selection system for 15 years, 74 percent of the growing space is occupied by pines free from overhead shade. Stocking was determined on the basis of 100 mechanically spaced milacre plots on each 40-acre compartment: These plots were considered stocked if they contained one pine seedling, sapling, or tree, or if they were shaded by the vertical projection of a pine off the plot.

Forty-seven percent (varying from 27 to 61 percent) of the area was shaded by overstory pines. Another 27 percent was occupied by small pines not shaded by larger pines or hardwoods. The resulting figure--74 percent of the area occupied by pines free to grow--is not a bad proportion, considering that the hardwood control program has not been completed. At present, more than half of the milacres dominated by hardwoods contain some pine reproduction.

Much of the hardwood competition was found on 6 of the 24 compartments. Since the tally was made, some of these compartments have been given stand improvement treatments in which about half of the stems 3.5 inches and larger were cut for distillation wood and the rest were girdled. To date, total out-of-pocket costs for timber stand improvement have been $2.51 per acre.

East Texas Cutting Plots Remeasured 15 Years After Establishment

In 1938 several series of plots were established in a heavy stand of 45-year-old shortleaf and loblolly pine on the San Jacinto Experimental Forest, in east Texas. At establishment, the plots were cut to various degrees of stocking. Subsequent management has also differed somewhat from one series of plots to the next. All the plots heavily cut in 1938 benefited from the good seed year and favorable weather conditions that followed. The less heavily cut plots with heavier residual stands had less opportunity to take advantage of the exceptionally good seed years and weather at the early part of the 15-year period (although they were relatively well stocked at the time of the 1953 observations).

Table 8 shows, in terms of the basal area of trees larger than 3-1/2 inches in d. b. h., the residual pine stands of 1938 and subsequent periodic net growth (including ingrowth and any harvest cutting). The table also includes information on the heavy mortality during 1948-53 and on need for reproduction.

Table 8. --Pine basal area, basal area growth, and need for reproduction on San Jacinto plots

1938 residual stand	1938-43 net growth	1943 residual stand	1943-48 net growth	1948 residual stand	1948-53 net growth	1948-53 mortality	Proportion of area needing reproduction
- - - - - Square feet per acre - - - - -							Percent
0	3.6	3.6	13.3	16.9	17.7	1.8	59
15.6	4.9	20.5	10.0	30.5	11.8	.7	15
25.6	5.9	31.5	6.1	37.7	8.6	.8	15
69.4	10.9	80.3	12.4	52.4*	1.7	4.0	23
70.7	8.6	79.3	12.0	63.5*	0	7.5	5
77.2	10.3	87.5	10.9	98.4	2.0	4.4	7
79.1	8.1	87.2	7.6	66.4*	-.1	6.0	12
99.9	9.6	99.8*	3.8	80.2*	1.2	6.5	6

*Indicates that basal area shown was left after a thinning which was taken into consideration in calculating growth of the previous 5 years.

It is apparent that ingrowth from reproduction accounts for the currently high basal area increments on the plots cut heavily in 1938. It is also apparent that mortality during 1948-1953 (including exceptionally bad drouth years) was quite high on the more lightly cut plots having more than 50 square feet per acre of pine basal area. All plots are in need of hardwood control at present.

Loblolly Pine Seed Trees Can Be Judged by Past Performance

Landowners wishing to reproduce their loblolly pine stands by means of seed trees should leave trees at least 12 inches in diameter and, more important, trees which have had cones in previous years.

The cone count on tagged trees near Crossett, Arkansas, was lighter in 1954 than it has been in the past four years. But past cone producers (those that had produced cones prior to selection in 1949) bore nearly ten times as many cones as did past non-producers.

Unmanaged Black Willow Grows Rapidly in the Mississippi Bottomlands

Some interesting data on the growth potential of black willow (*Salix nigra* L.) were obtained during the establishment of a willow thinning study near Arkansas City, Arkansas. The area is the Choctaw Island property of the U. S. Gypsum Company. This unmanaged 24-year-old stand has a total volume averaging 3,710 cubic feet per acre in trees larger than about 6 inches d. b. h. Average growth has been 155 cubic feet or about 1.8 cords per acre per year, not counting the volume lost through natural thinning. Basal area averages 129 square feet per acre and the diameters of individual trees range from 6 to 24 inches. The board-foot volume (Doyle rule) in trees with diameters larger than about 15 inches is 3,772 (including only logs larger than 12 inches inside bark). By properly timed thinnings it is hoped that an annual growth rate of three cords per acre can be maintained for the remaining life of the stand.

One of the thinning test plots is shown in Figure 7.

Yields of Longleaf Pine in South Alabama Best Where Thinning Was Light

On the Loxley plots in Baldwin County, Alabama, heavy thinning of longleaf sapling stands at age 22 increased the diameter growth of the largest dominant trees but failed to increase total cubic-foot yields. The plots were thinned 20 years ago, when trees were 22 years old. They were rethinned 15 years later, at age 37. The original thinnings

Figure 7.--A 24-year-old black willow stand. Left: Before thinning, this stand contained 3,710 cubic feet per acre. Average basal area was 130 square feet. Right: Same stand after thinning removed 997 cubic feet of pulpwood, reducing the basal area by 36 feet.

reduced the stands to 200, 300, or 400 trees per acre. Unthinned checks averaged 1,724 trees. Volume and diameter growth to date are summarized in table 9.

The heaviest thinning has, so far, been the least profitable. A slight gain in diameter growth has been attained at the expense of a considerable loss in cubic-foot yield.

Growth responses from these plots are interesting but leave many questions unanswered. Lighter thinnings at an earlier or later date might have been better. Furthermore, plots were small, isolation strips were narrow, and important stand-structure variables were not measured.

Table 9.--Effect of heavy thinnings on growth of longleaf pine stands

Treatment at age 22 1/	Total yield per acre at age 42 2/	Average d. b. h. of 50 largest trees per acre at age 42
	Cu. ft.	Inches
Thinned to 200 trees per acre	2, 730	11. 0
Thinned to 300 trees per acre	2, 918	10. 8
Thinned to 400 trees per acre	3, 089	10. 6
Unthinned (1, 724 trees per acre)	3, 064	10. 1

1/ All plots (including the checks, which had stagnated) were thinned at age 37.
2/ All thinnings plus present volume.

Pine Reproduction in North Alabama Helped by Utilization of Hardwood, Slightly Hurt by Tractor Logging

In two different areas in north Alabama, the silvicultural effects of logging on pine reproduction were observed. Two years after merchantable hardwoods larger than 6-1/2 inches in d. b. h. were removed(except for a few choice crop trees), loblolly-shortleaf pine stocking increased from 47 to 76 percent, with seedlings increasing from 1, 094 to 2, 505 per acre.

In another area already 73 percent stocked with pine seedlings (3, 176 per acre), logging with a crawler-type tractor caused a relatively slight reduction in stocking--to 65 percent (2, 382 seedlings).

Low-Grade Hardwoods Profitably Harvested as Pulpwood in South Mississippi

On the McNeill Experimental Forest, low-grade hardwoods that were left along stream courses after pine sawtimber cuttings have been interfering with regeneration of desirable slash pine, yellow-poplar, and sweetgum. Recently residual blackgums and sweetbays that were too crooked and defective to leave for future

growth were harvested locally for pulpwood. The cuttings paid for themselves and left the stands in much better condition for regeneration of desirable species.

Direct costs for hand felling, bucking, and peeling were $6.75 per cord for labor (at $0.90 per hour) and $1.33 per cord rental for the bow-type power saw used for bucking into pulpwood bolts. The bolts, sold on the ground where they were cut, brought $9.61 per cord. Supervision and crew transportation are not included in the above figure, but would be less than the $1.53 per cord differential between direct costs and return.

Timber Stand Improvement (TSI) in North Alabama

Unwanted hardwoods can be girdled with a machine in about half the time it would take to do the same job with an ax. In a study near Birmingham, Alabama, it was found that girdling time with the machine (the "Little Beaver") could be predicted from the number of trees to be girdled (N) and the sum of their diameters in inches (sum D). The formula is:

$$\text{Man-hours} = .003641\ (\text{sum D}) - .008017N$$

For the same area and type of timber a formula for notch girdling with an ax is:

$$\text{Man-hours} = .006005\ (\text{sum D}) - .010066N$$

It is advisable to check these constants against some that have been locally derived before applying the formulae in areas with timber types or topography differing from those found in north-central Alabama.

This work was reported in Southern Forestry Notes 94.

In an informal study of depth of ax girdling it was found that the deeper the girdle the quicker and more complete the crown kill. The depths of girdling tested were: through the bark; one chip out of the sapwood; and sapwood completely severed. When these treatments were applied to post, scarlet, and southern red oaks in May, complete crown kill was obtained on 75 percent of the bark-girdled trees, 92 percent of the chip-girdled trees, and 100 percent of the deep-girdled. Average times required for complete crown kill were 81 days, 67 days, and 11 days respectively.

TSI in South Arkansas

At Crossett, Arkansas, a good kill of southern red oaks 4 to 10 inches in diameter has been obtained at all seasons of the year by frilling and applying a mixture of 1 gallon of low-volatile 2, 4, 5-T ester (4 pounds acid) per 100 gallons of water. One year after treatment, the crown kill varied from 91 to 100 percent with only minor differences between seasons of application. However, sprouting has been heaviest so far on trees poisoned in the summer. Only 29 percent of these trees are free of sprouts while about 87 percent of the trees treated in the fall, winter, or spring have no sprouts.

If a slower kill and more sprouting can be tolerated, notch girdling may be used in place of poison in frills. Ninety-six percent of a number of girdled 4- to 8-inch southern red oaks were crown-killed within two years of treatment. Sprouting was fairly heavy. However, it was found that sprouting could be minimized by girdling between April 15 and June 30. This period, which roughly corresponds to the time when the trees attain full leaf, also tends to give a faster crown kill. Similar results were obtained for post oak.

TSI in West Florida

In the sandhills of west Florida the common timber stand improvement measures are seldom applicable. Many of the undesirable oaks are so small that the treatment of individual trees is not economic. There is also considerable evidence that not only the oaks but also the ground vegetation (wiregrasses, gopher-apple, and the like) must be removed before pines can become established and make good growth.

One approach is the use of chemicals that are applied to the soil rather than directly to the plants. No satisfactory soil poison has been found, but the two most promising ones are TCA (sodium trichloroacetate) and Karmex W [3-(p-chlorophenyl)-1, 1-dimethylurea; formerly called CMU]. Two years after TCA was applied at a rate of 40 pounds per acre, it had reduced the ground cover and scrub oak stand by about half. A dosage of 120 pounds per acre did not reduce the ground cover below that obtained at two years by the lighter dosage but did increase the kill of scrub oaks to 83 percent. These figures may not indicate the full effectiveness of TCA in killing the ground cover, for maximum kill is obtained about 60 days following application, after which lesser vegetation recovers and trees cease to die. One great advantage of TCA is that its residual effect (9 months after application of 120 pounds per acre) was not enough to kill freshly planted slash pine seedlings.

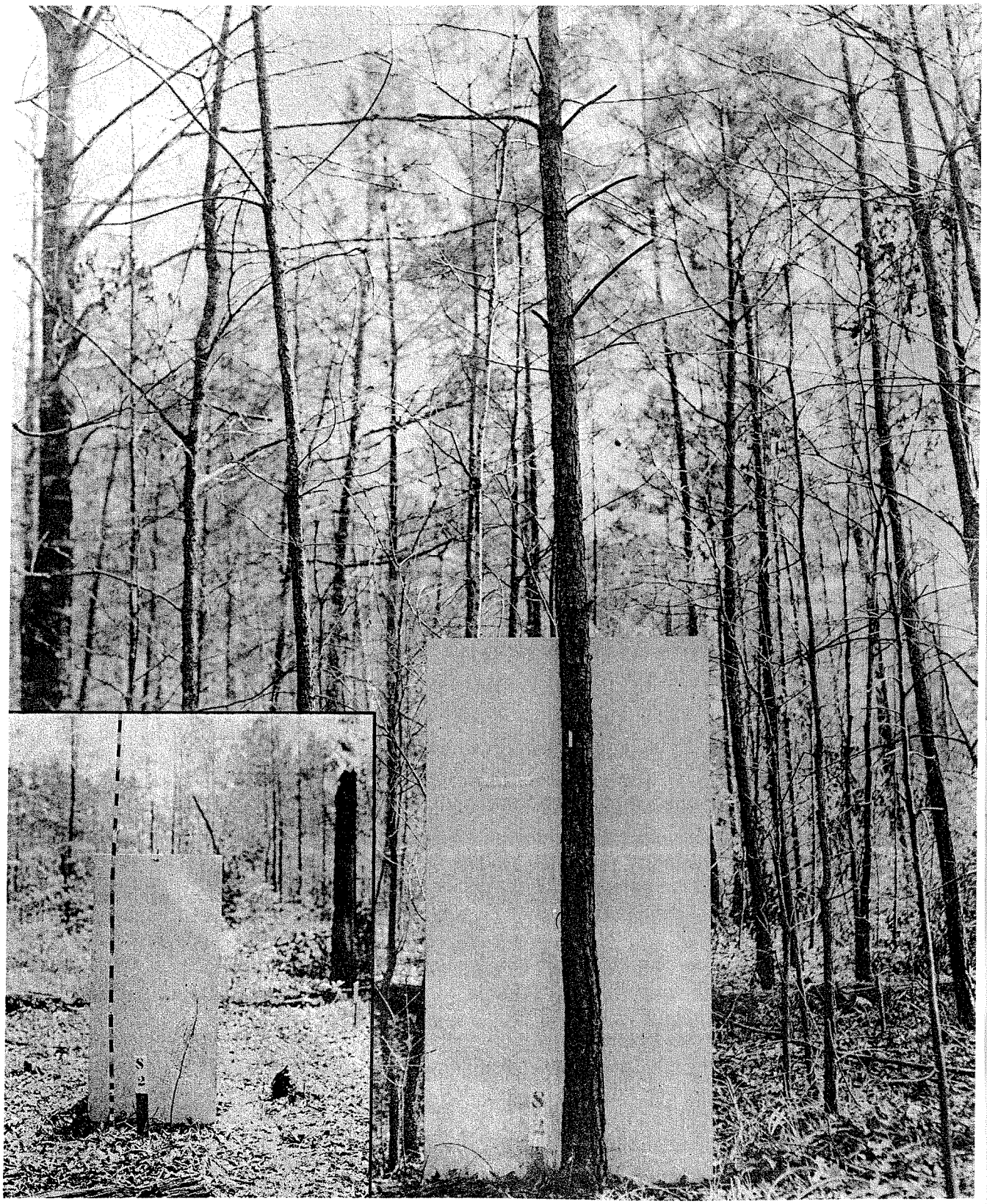


Figure 8. --A loblolly pine seedling just after being released from low-grade hardwoods--and the same tree 12 years later.

Figure 9. --Soil sterilants kill scrub oaks and wiregrass. But how long will they remain in the soil and prohibit pine growth?

When applied at the rate of 11 pounds per acre, Karmex W killed nearly all scrub oaks but only about 7 percent of the wiregrass. About 25 pounds per acre was required to kill 75 percent of the wiregrass. Karmex W remains effective for rather long periods. Unfortunately, nearly 60 percent of the slash pine seedlings died when planted where Karmex W had been applied 9 months previously at a rate of 11 pounds per acre. On an area where 44 pounds of Karmex W had been used, 76 percent of the slash pine seedlings planted 2 years after treatment were dead or badly chlorotic.

TSI in Mississippi Bottomland Hardwoods

Two methods have been found effective for killing unwanted bottomland hardwoods larger than 5 inches d.b.h. They are notch girdling, and applying Ammate or 2,4,5-T in frills. Basal spraying

with 2, 4, 5-T was also tested but has not given very satisfactory results. Two years after spring application in a test near Stoneville, Mississippi, the various treatments have the following crown kills: notch girdling, 89 percent; 2, 4, 5-T in frills, 83 percent; Ammate in frills, 82 percent; and basal spray, 41 percent. Sprouting was negligible in all treatments. Both sprouting and crown kill were undoubtedly influenced by two factors. One is the record drouth of the past 2 years. The other is that the treatments were applied in May--a month that other studies have shown to be one of the least favorable to profuse sprouting.

The 2, 4, 5-T in frills was the cheapest of the four methods tested. Total cost of treating 20 ten-inch trees per acre (or 10 twenty-inch trees, etc.) would be $1.43 for 2, 4, 5-T in frills; $1.65 for girdling; $1.74 for Ammate in frills; and $2.13 for the basal spray.

The chemicals were used in the following concentrations:

> 2, 4, 5-T in frills--one gallon of commercial product (a low-volatile ester containing 4 pounds 2, 4, 5-T acid equivalent) to 50 gallons of water.
>
> Ammate in frills--four pounds of Ammate crystals per gallon of water.
>
> 2, 4, 5-T basal spray--one gallon of 2, 4, 5-T (low-volatile ester containing 4 pounds 2, 4, 5-T acid equivalent) in 20 gallons of No. 2 diesel oil.

In supplementary tests there were indications that a simple frill will not reliably kill bottomland hardwoods. One year after they had been frilled, trees of several species of bottomland hardwoods showed only 46 percent crown kill. The use of 2, 4, 5-T in frills gave a crown kill of 61 percent in one year.

All of these tests provide convincing evidence that care in frilling or girdling is necessary. In one study, more than half of the trees failed to die because the frill or girdle was incomplete--usually in deep catfaces.

Articles on pages 123 and 130 of the December 15, 1954, issue of the Southern Lumberman report additional details on TSI in bottomland hardwoods.

TSI in East Texas

Highly concentrated solutions of 2, 4, 5-T have not proved as good as more dilute solutions when used to control sprouting from the cut stems of small sweetgum and post oak. In a study on the Stephen F. Austin Experimental Forest, near Nacogdoches, Texas, sweetgum and post oak less than 3.6 inches in d.b.h. were cut off close to the ground. With an "atomizing" squeeze bottle an undiluted solution of low-volatile commercial 2, 4, 5-T ester (4 pounds acid per gallon) was sprayed on the cut surfaces. Compared with this were cut stems without any chemical treatment and cut stems painted with a low-volatile 2, 4, 5-T solution containing 4 pounds of acid equivalent per 20 gallons of diesel oil. Treatments were applied in June.

One growing season later, 40 percent of the stumps treated with concentrated 2, 4, 5-T were free of sprouts. This was better than the 26 percent recorded where no chemical had been used but far short of the 98 percent sprout control obtained with the diluted 2, 4, 5-T. However, the diluted mixture was used in dosages approximately 3 times that of the atomized concentrate.

Another observation on the behavior of east Texas trees treated with 2, 4, 5-T is that a low-volatile ester (propylene glycol butyl ether) is just as effective as a high-volatile ester (pentyl in this test) when applied in May as a basal spray on sweetgum stems. Only 55-75 percent of the stems were killed by either basal spray, however.

Sudden Sawlogs for South Arkansas

Concentrating all growth on a few selected crop trees so as to produce sawlogs in the shortest possible time has an appeal to both foresters and landowners. It may work too.

At Crossett, Arkansas, 100 loblolly pine crop trees per acre were currently selected in a nine-year-old plantation. The crop trees were pruned to a height of at least 9 feet. All other trees on the area were cut down. Average diameter growth in the first season following treatment was 0.68 inch. In contrast, the diameter growth of 100 unpruned crop trees on an uncut area averaged 0.32 inch.

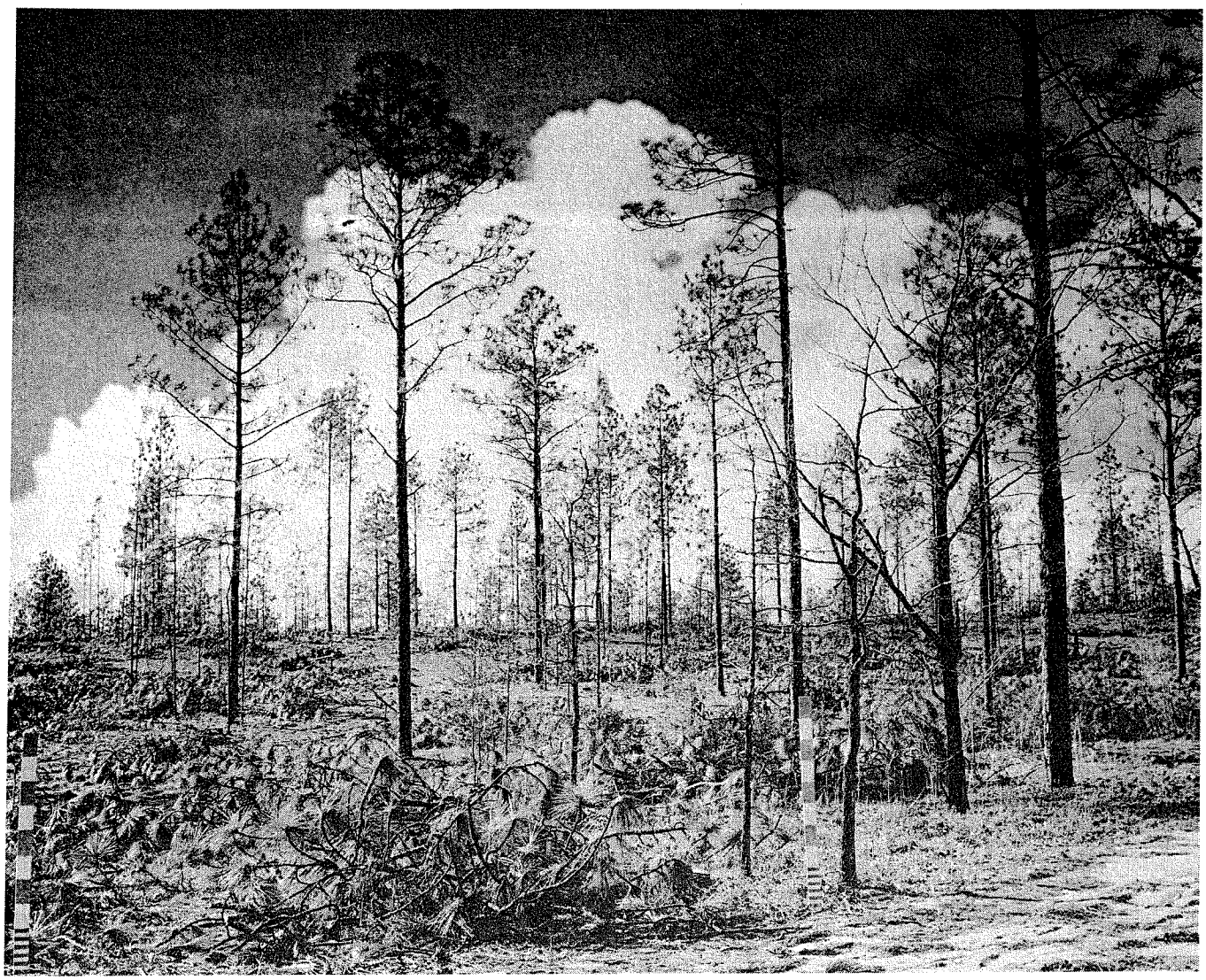
As a compromise between these extremes, 100 crop trees per acre were pruned but no competing trees were cut unless their crowns were within 5 feet of the crown of the crop tree. Average diameter growth of these crop trees was 0.52 inch. It is possible that the intermediate returns from pulpwood provided by this treatment will offset the poorer diameter growth.

Longleaf Pine Mortality Varies in South Alabama and South Mississippi

Near Brewton, Alabama, where 24 forty-acre compartments are being naturally regenerated by various methods, 5 years' observation has shown that only about 4/10 of 1 percent per year of second-growth longleaf seed trees were lost to various causes when sawlog stand density was 8 trees per acre (fig. 10). When residual stand density was 32 sawlog trees per acre, only about 2/10 of 1 percent per year of second-growth longleaf trees were lost. Lightning accounted for about half the losses in each case. Miscellaneous causes other than windthrow or insects made up most of the remaining losses.

Near McNeill, Mississippi, well managed second-growth longleaf trees have suffered an annual loss of almost 2 percent for the past

Figure 10.--In the 5 years since this longleaf pine stand was cut to 8 seed trees per acre, mortality has averaged 4/10 of one percent per year. Brewton, Alabama.



5 years. Almost half the mortality was attributable to ice damage, with hurricanes and the black turpentine beetle each accounting for about half of the remainder. The ice loss was principally in smaller trees and the wind and beetle loss in the larger trees.

Underground Tactics of South Arkansas Hardwoods

Much of the so-called "re-invasion" of hardwoods into areas from which they were supposedly eliminated is apparently due to hardwood rootstocks that survived the eradication treatments. Reestablishment of hardwoods by far-flying seeds does not seem to merit the importance it is often given.

Three years ago the hardwoods on a series of plots near Crossett, Arkansas, were poisoned with Ammate. Treatments were repeated until all the original stems and the sprouts from them appeared dead. All hardwoods of seed-bearing size that were within one-quarter mile of the plots were also poisoned. Each spring since that time every hardwood appearing on the plots has been dug up and examined to determine its origin.

Despite the intensive control measures, over 300 stems per acre were found in the spring of 1954. Of this number, 97 percent came from old rootstocks.

The treatment was more effective against the oaks, sweetgum, and dogwood than against blackgum, persimmon, red maple, sassafras, and elm. This latter group of species is able to maintain active root systems despite a large amount of rough treatment. Of the very small number of hardwoods that may have come from new seeding, two-thirds were sassafras. The remaining one-third were red maple.

Watershed Management

Stand Conditions and Soil Moisture in South Arkansas

Available soil moisture may at times be over five times as great in soils on which large cull hardwoods have been deadened as in soils under undisturbed hardwoods. But this advantage diminishes the first year after deadening as understory vegetation begins to replace the culls. Soil moisture remains relatively high on both treated and untreated sites until about the end of May. After that, depletion is very rapid on untreated sites.

These trends were noted in a study of soil moisture depletion made under six different forest cover conditions near Crossett, Arkansas. Records were kept on three undisturbed forested sites and three sites from which various proportions of the vegetation had been removed. It was found that in undisturbed all-aged pine or hardwood stands with a stocking of 70 to 100 square feet of basal area per acre, available soil moisture dropped from about 13 inches (in the 0-48 inch depth) in May to less than 2 inches in September. In contrast, all-aged hardwood sites on which the large hardwood culls had been deadened just prior to initiation of the study only dropped from 13 to 11 inches of available moisture over the same period. Young hardwoods depleted the moisture a little less rapidly than did all-aged hardwoods or pines. Hardwood sites on which the culls had been deadened two years before were intermediate in their trend of soil moisture depletion, dropping from 13 to 6 inches of available water. Leaving deadened trees standing seemed to conserve a little more moisture in the upper 12 inches of soil than did complete removal by clearcutting, but no appreciable difference could be detected in moisture below that depth.

The detailed results of this study may be found in "Soil Moisture as Affected by Stand Conditions," published as Occasional Paper 137.

Erosion Control Planting in North Mississippi

Preventing the cancerous advance of old erosion scars and reclaiming the land from past damages is a problem of tremendous importance in north Mississippi--as it is in many other areas. For this reason much of the program of the Tallahatchie Research Center is devoted to problems of watershed management. It has been found that loblolly pine plantations do an excellent healing job for certain types of gullies (fig. 11), and additional studies of methods of planting, preparation of critical sites, and alternative plant species are being conducted.

The soil conditioner Krilium has not improved either survival or height growth of loblolly pine planted for erosion control on hard-packed gully bottoms in north Mississippi.

The development of loblolly seedlings on poor to extremely adverse sites treated with Krilium (formulations 6 and 9) was compared with that on cultivated and untreated check plots. After three growing seasons, differences in survival and growth among treatments were not significant. Survival over-all averaged 82 percent and ranged from 71 percent on check plots to 91 on those cultivated. Growth was poor because of the severity of the test sites. Height growth in three years averaged 10 inches and ranged from 8 on the check plots to 12 inches on cultivated plots.

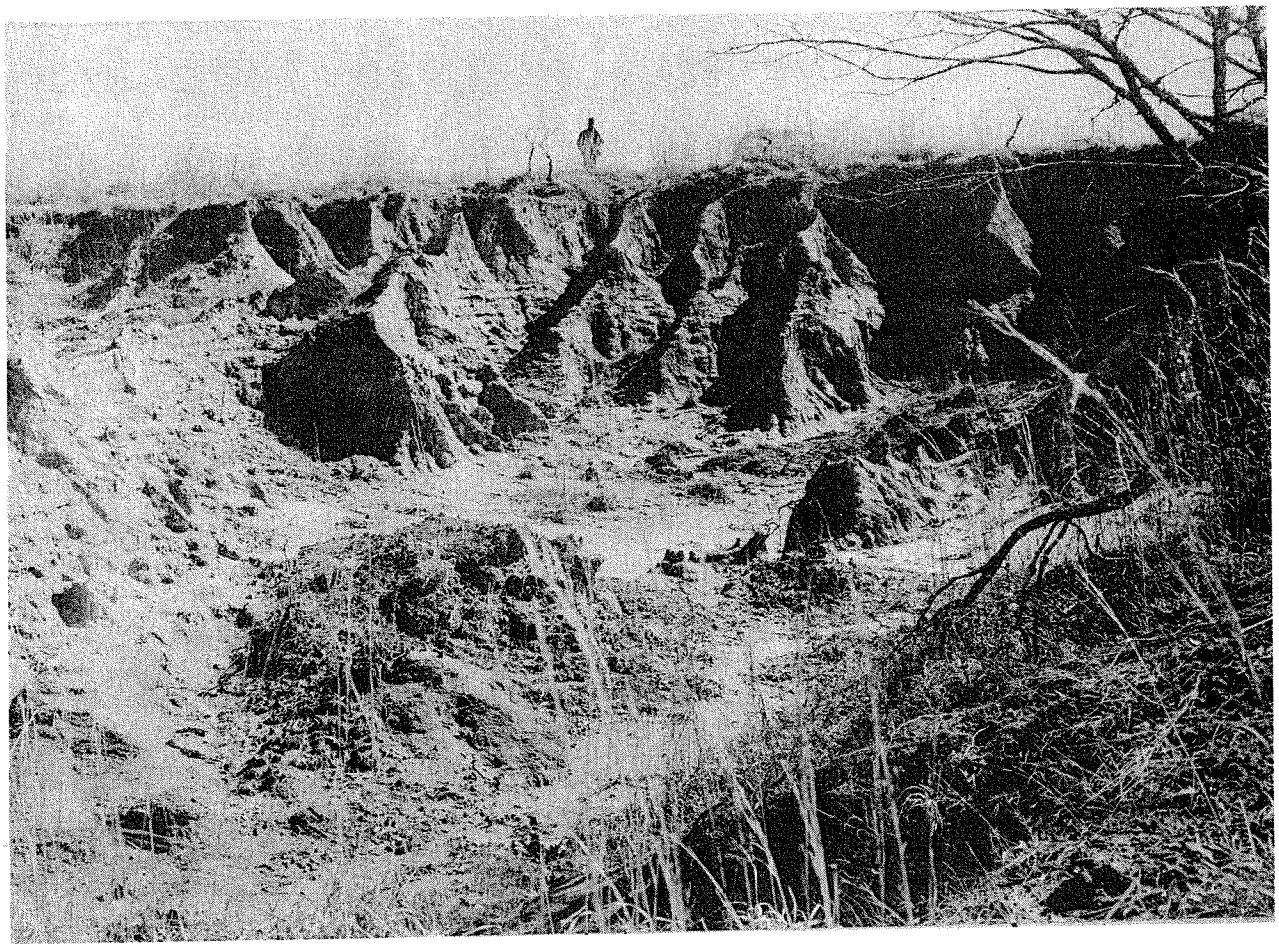
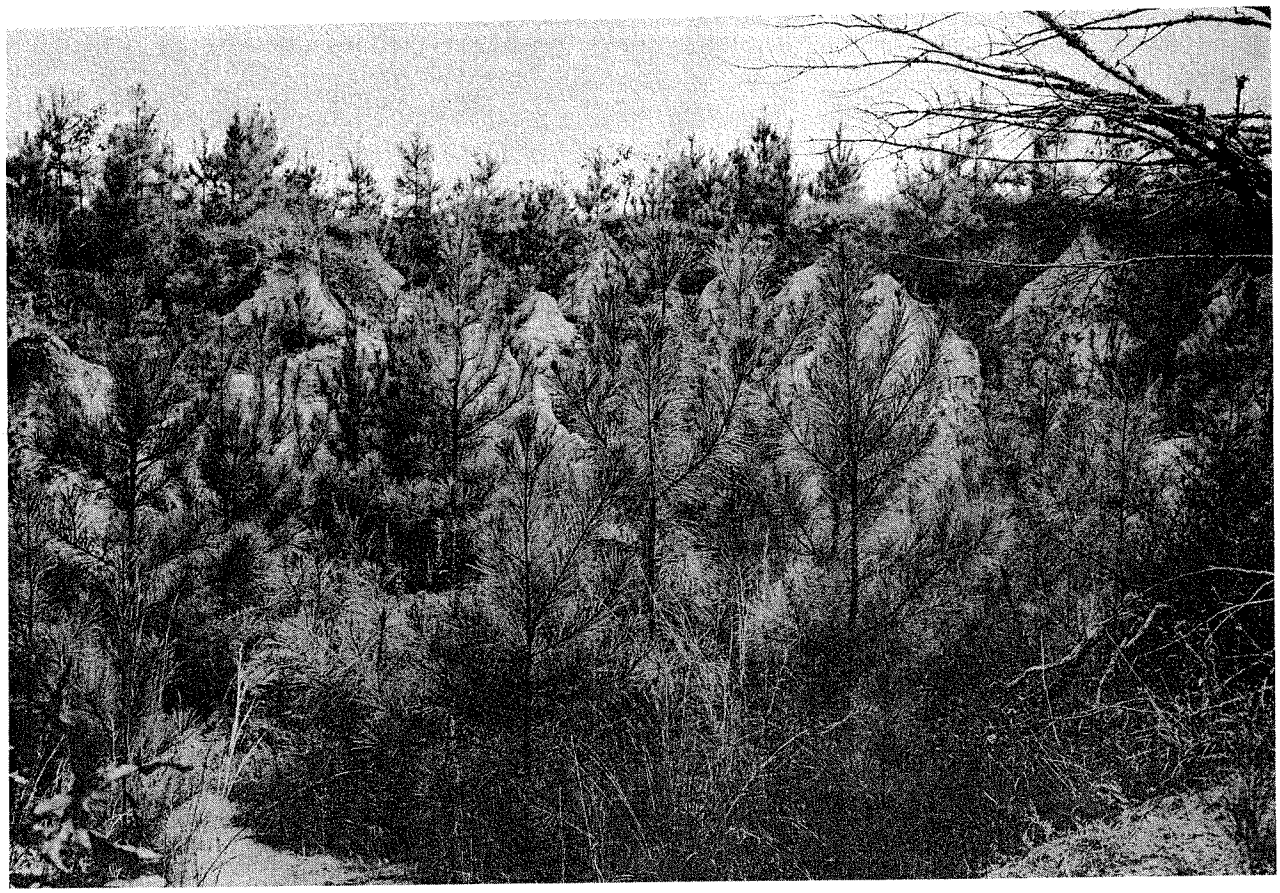


Figure 11.--Above: An active gully in the Brown Loam area of north Mississippi. Below: The same gully 4 years after it was planted with loblolly pine. It is not easy to get seedlings started on gully sites. These were lightly mulched at the time of planting.



Vicksburg Infiltration Project

This Project, located at the Waterways Experiment Station in Vicksburg, Mississippi, continued its work on the prediction of soil moisture content. The work is being done for the Corps of Engineers, in connection with the Army's study of the relation of various soil factors to soil strength and the mobility of military vehicles.

In the first half of 1954, field parties of the Project continued the collection and study of soil-moisture, soil-strength, and weather records at Albuquerque, New Mexico; Delta, Colorado; Crossett, Arkansas; Rhinelander, Wisconsin; and Spokane, Washington. In the latter half of the year, the Project began a survey of strength-moisture conditions in the major soils in the United States. One survey party is headquartered at Vicksburg and covers a wide variety of soils and sites in six southern states. Other parties are working at the Lake States, Northeastern, and Intermountain Forest Experiment Stations. These parties have established 630 sites which they will visit 8 times for soil-moisture and soil-strength measurements before the close of the survey in June 1955.

Two representatives of the Project spent 5 months in Alaska studying soil moisture, soil strength, and permafrost. Personnel at Vicksburg, although continuing to collect records of soil moisture and weather (including solar radiation), put major emphasis on analysis of data supplied by Project field parties and cooperating agencies.

Progress to date includes the development of a feasible method for predicting soil-moisture content, and the establishment of prediction relations or criteria for a wide variety of experimental sites, numbering 85 in all.

A four-volume progress report (number 3), "Forecasting Trafficability of Soils: The Development of Methods for Predicting Soil Moisture Content," summarized the results of the first two years' effort. It was issued for official use in October 1954 but is not available for general distribution.

Publications of the Project during 1954 include "Some field, laboratory, and office procedures for soil-moisture measurement," Occasional Paper 135; "Properties affecting water relations and management of fourteen Mississippi soils," Bulletin 521 of the Mississippi Agricultural Experiment Station; and "Infiltration and available water storage capacity in the soil," Transactions of the American Geophysical Union, vol. 35, pages 791-795. A popular account of the Project's work appeared on pages 208-209 of the Southern Lumberman for December 15, 1954.

Mensuration

The Wedge-prism: A Handy Angle-gauge for Point-sampling

A new and convenient hand-held instrument has been devised for gauging whether trees qualify for count in point-sampling (or variable-plot-radius sampling). In its simplest form, it consists of a small oblong wedge-prism measuring about 1/2 inch by 1-1/2 inches.

The stick-type angle-gauge for estimating tree basal area per acre or volume per acre is already familiar to most foresters. A wedge-prism can advantageously replace the stick in many situations, since using the prism requires only a single visual comparison (unaffected by shaky hands) instead of two simultaneous visual comparisons (complicated by stick wobble).

As can be seen from figure 12, decision as to whether trees qualify for count depends merely on whether the deviated image of the tree (viewed through the prism) appears to overlap the direct image of the tree (viewed over the prism). If a wedge-prism having a strength of 3.03 diopters is used as an angle-gauge, then basal area in square

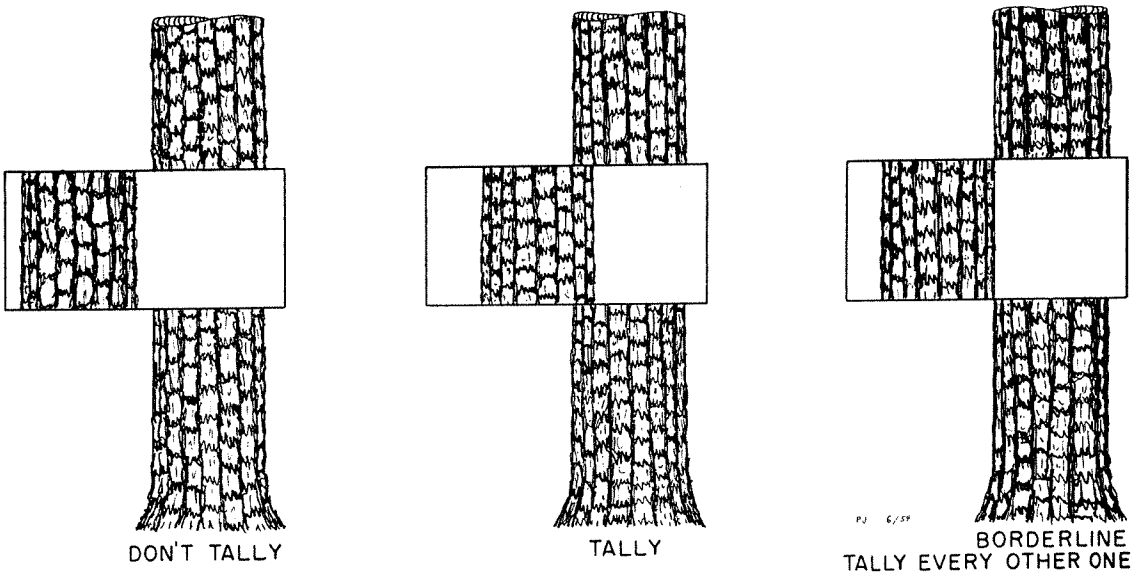


Figure 12.--How to decide which trees to tally when using the wedge-prism as an angle-gauge.

feet per acre is estimated as the average number of trees counted at a sample point, multiplied by 10.

With the stick, the accepted method for optically compensating for slope has been to pivot the cross-piece in the plane of the lines of sight. With the prism, the slope compensation can be achieved by pivoting the prism around the line of sight. If desired, the prism can be incorporated into optical systems providing magnification.

An article entitled "A New Way to Look at Trees," on pages 163-167 of the Journal of Forestry for March 1955, gives details on how to make and use the new device.

New Tree Measurement Concepts

A novel technique for tree volume calculations has been developed which allows using bookkeeping machines and mark-sensed punched-cards to a greater extent than conventional methods, and which allows break-down of class volumes into different sizes or grades with little additional work. Heights up the tree stem are measured or estimated to a regular progression of diminishing diameters, and machines are then used to obtain the sum of these heights and the sum of their progressive totals. Individual tree volumes never need be computed, but class volumes in board feet or cubic feet can be readily calculated from a few appropriate height accumulations involving many trees.

Also, a unique cumulative table of volume and surface has been computed for a conoid with a 50-inch base tapering for 400 feet at the rate of 1/8 inch per foot. Surface and volumes (cubic foot and board foot according to International log rule with 1/4-inch kerf) are given for each whole foot of length and each 1/8-inch of diameter. This allows calculating the surface and volume of a solid having any whole-foot length or fractional-inch diameter within the limits of the table. The calculation involves entering the table at a measured diameter and exiting after moving through the table for the measured length, and then subtracting exit volumes and surfaces from entering volumes and surfaces.

The above material is discussed in Occasional Paper 134, along with some underlying theory and some formulae and tables indicating the effect of erroneous assumptions as to tree taper and shape.

More Delta Hardwood Growth Plots Established Cooperatively

The Southern Hardwood Forestry Group (cooperating with the Delta Branch of the Southern Forest Experiment Station) increased the number of permanent 1/5-acre growth and mortality plots in bottomland hardwood stands from less than 200 last year to 500 this year. The ultimate goal is to have 1,000 plots.

Various forest types, stand classes, and sites are represented. Periodic growth will be analyzed and correlated with stand structure.

Forest Diseases

Pine Tree Diseases

Fusiform rust of southern pines. --After six years in a south Mississippi plantation, slash pines (typical) (*Pinus elliottii elliottii*) from seven seed sources show no marked differences in susceptibility to fusiform rust. Seed sources range from Louisiana to north Florida. Field infection varied between 50 percent for seedlings of Louisiana and Mississippi origin to 60 percent in a lot from Alabama. In a 5-year planting at the same location, slash pine (typical) from Mississippi and north Florida, and south Florida slash pine (*P. elliottii densa*) from south Florida, showed 62, 56, and 16 percent infection, respectively. Though south Florida slash appears less susceptible to fusiform rust than typical slash pine, its survival and growth have been poor in this and other tests in south Mississippi.

About 70 rust-free slash pines have been selected in 15-year-old plantations on the DeSoto National Forest, where up to 95 percent of the individuals are rust-infected. The best morphological specimens among these 70 will be used as parent material in a study of resistance to fusiform rust.

Brown spot of longleaf pine. --Nine seed-source plantings of longleaf from North Carolina to Texas were examined after 11 and 20 months in the field. There were no marked differences in the amount of foliage killed by brown spot. Of the seedlings that were disease-free at 11 months, 8 (representing six seed sources) had only a trace of brown spot after 20 months.

Ascospores of brown spot were found to be present the year around, instead of only seasonally as had previously been thought. This may account for some of the rapid build-ups of this disease heretofore hard to explain. An article in Phytopathology for July 1954 gives additional details.

Nursery study. --Control of deleterious soil fungi through the use of ziram (Zerlate) in a pilot-plant test at the Ashe Nursery gave only 5 percent more loblolly seedlings on the treated than on the untreated area. In the spring of 1954 Zerlate was applied at the rate of 300 pounds per acre to a 40-foot wide strip across about 100 beds in the nursery and was immediately disked in. Beds were then prepared for sowing and were seeded with loblolly pine in the usual manner. Samples were taken in October from both treated and untreated areas of 30 beds. The increase, of 5 percent, was far less striking than that from a small plot study in 1952, when a similar treatment increased the number of plantable longleaf and loblolly seedlings by 34 percent.

The use of Zerlate would not appear to be justified except possibly where poor seed has to be used or where losses from damping off or decay of germinating seed are considerable.

Southwide Pine Seed Source Study Progresses. --Damage from insects and diseases was light in the one-year-old plantations in this cooperative study. Fifty-one plantings from North Carolina to Louisiana were examined by entomologists and pathologists of the Southeastern and Southern Stations. No plantations have been wiped out by pests as yet, but considerable variability in immunity is beginning to show up, and it is possible that significant differences can be detected in the next few years.

Hardwood Tree Diseases

Sweetgum blight has continued to increase in amount and intensity in the Delta. Since 1953, mortality on the disease-progress plots has increased from 0 to 10 percent. Articles in the Southern Lumberman for September 1, 1954, and the Plant Disease Reporter for February 15, 1954, give more detail about the progress of the blight.

Poria spiculosa, the fungus that causes rough circular cankers and swellings around branch traces of willow oak, Nuttall oak, and honeylocust, was found to be associated with heavy heartrot in the Delta. Rot increased in length approximately 0.8 foot per year. This is the first report of the fungus on honeylocust. Further information is given in the December 1954 Journal of Forestry.

Analysis of 55 *Polyporus hispidus* cankers on willow and Nuttall oaks in the Mississippi Delta revealed that heartrot behind the cankers extended $2.38 \pm .993$ feet beyond the limits of the cankers, and that the cankers and rot increased $0.484 \pm .017$ feet in length per year. Publication of these findings is expected in 1955.

Dissection of nine bottomland red oak trees one year after inoculation with Fomes geotropus and Polyporus hispidus indicated that rot had spread 1.5 inches up and 1.5 inches down from the point of inoculation, as compared to a 2.5 inch up-and-down spread for P. fissilis. Figure 13 illustrates the action of typical heartrot fungus (Fomes geotropus) spreading from a known point of infection.

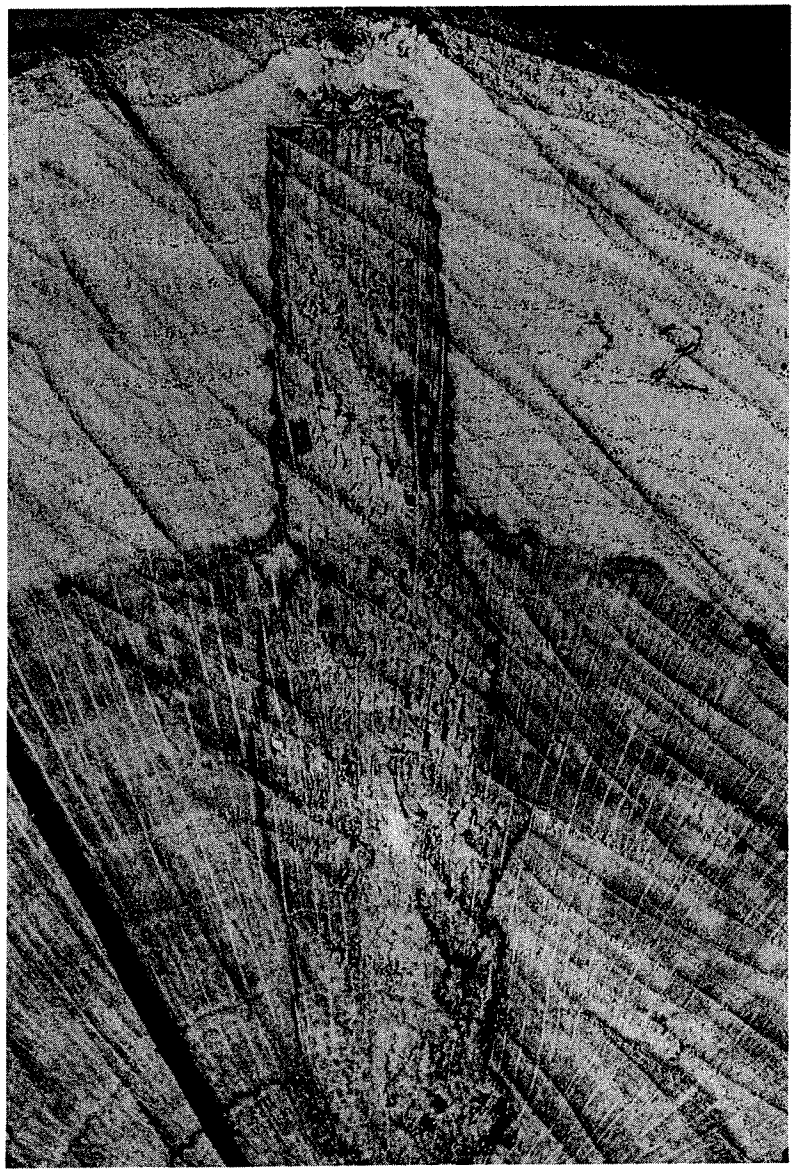


Figure 13.--Cross section of a willow oak tree inoculated with a heartrot fungus one year ago.

Fusarium lateritium, isolated from dying red mulberry twigs in the Delta, reinfected all twigs inoculated. Eight months after inoculation, 65 percent of the inoculated twigs were dead. All uninoculated twigs remained healthy.

Inoculations in the Delta indicate that the fungus Fusarium negundi can cause red stain in living boxelder trees. A brief article on this subject appears on pages 66-67 of the Plant Disease Reporter for January 15, 1955.

One year after inoculation with two unidentified fungi isolated from cankers on honeylocust twigs in the Delta, 60 and 75 percent of healthy honeylocust twigs had developed cankers. No twigs have been killed as yet.

Yellow-poplar dieback is increasing on the Tallahatchie Experimental Forest in north Mississippi. Cankers three to six inches long were found around 75 percent of the previously healthy stems which had been inoculated a year earlier with material from affected stems. All of the check wounds had healed over. On an observation plot established a year ago, 49 percent of the trees are now definitely worse. An article on the subject appeared in the Plant Disease Reporter for November 15, 1954.

Oak wilt surveys in north Arkansas, north Mississippi, and west Tennessee showed the wilt to be of little importance in these areas. Only one infected tree was found, in extreme north Arkansas.

Treatments Help Protect Ammunition Boxes

Test piles of ammunition boxes were examined after about 18 months' outdoor storage in Panama, Mississippi, and Wisconsin. A complete description of the tests and results to date was presented in a report published by and obtainable only from Frankford Arsenal (U. S. Army Ordnance Corps Report R-1213). Included are provisional recommendations for the treatment of such boxes.

At Gulfport, Mississippi, preservatives coupled with water repellents and applied as 3-minute dips continued to keep treated boxes reasonably dry except during periods of excessive rainfall. Protection was not perfect but definitely beneficial. In contrast, the best solutions failed to prevent heavy moisture pickup under wet jungle exposure in Panama.

Water solutions of sodium pentachlorophenate have given better protection than the same concentrations of pentachlorophenol in oil. The difference was particularly striking in stain and mold control. Also, when suitable wax emulsions were added to the water solutions, good water repellency resulted. Apparently the cheaper water solutions of phenate will protect products such as boxes better than was previously believed.

The new wire-bound veneer ammunition boxes were treated and exposed. One-second immersions of hardwood veneer in oil solutions resulted in higher absorptions than did 3-minute dips of pine lumber boxes. The tests indicate that an in-and-out dip will give adequate absorptions for rotary-cut hardwood veneer. Wire-bound boxes are shipped to arsenals in knocked-down bundles. The short immersions plus the opportunity of handling the boxes in bundles should enhance the commercial feasibility of treatments.

Siding Panel Tests

Earlier data have shown that decay hazard of wood siding can be reduced by the use of breathing sheathing papers, water-repellent dips, good roof overhang, and the placement of trim over the ends of drop siding. Experimental evidence has now been secured on two additional factors--the effects of using infected siding and of putting drop siding over wood sheathing.

Moisture determinations were made on siding panels on 19 days during a 3-month period of heavy precipitation (143 percent of normal) and again on 24 days during a 3-month period of low rainfall (44 percent of normal).

Table 10 shows average number of siding ends with dangerously high moisture contents (over 20 percent).

Table 10.--Influence of infested lumber and wood sheathing on moisture content of siding

Panel construction	Proportion of siding ends containing over 20 percent moisture	
	Wet period	Dry period
	- - - Percent - - -	
Drop siding over breathing paper, no other sheathing		
Uninfected siding	12	7
Siding infected with molds and stain	32	7
Drop siding (uninfected) over wood sheathing	71	17

Infections increased siding wetting but did not hinder drying. Wood sheathing, like vapor-barrier paper, prevented drying and led to dangerous accumulations of water in the siding. Obviously, wood or fiber sheathing board should not be used in a region of high rainfall unless good roof overhang is provided or the siding is treated with a water repellent.

Decay Resistance of Pine Sapwood Lumber

Two tests have failed to detect any difference in the resistance of air-dried and kiln-dried southern pine sapwood lumber to *Lenzites saepiaria*. Kiln drying apparently does not increase susceptibility to this common decay fungus. On the contrary, it kills any infections which may be in the wood and thus, on the average, should furnish better siding and other exterior woodwork than does air seasoning.

Water Repellents on Lumber Reduce Chances of Decay

When wood infected with stain, mold, or decay is used under conditions permitting rainwetting, it absorbs undue amounts of water. This increases the chance of decay or other troubles. To get information on the degree to which this absorptiveness could be overcome, pine sapwood infected with the mold Trichoderma was dipped in 5 percent pentachlorophenol plus a water repellent or 20 percent copper naphthenate plus a water repellent. Matched samples of non-infected wood were similarly treated. During four months' outdoor exposure the water-repellent preservatives reduced the rain wetting of the molded wood to the level occurring with the treated non-infected wood. However, the molded wood absorbed 5 times as much preservative as the non-infected.

Pulpwood Fails to Deteriorate at Expected Rate

Loss in specific gravity due to decay during 6 months' winter storage was too small to be measured by the techniques employed in small-scale testing. This applied to both pine and sweetgum bolts. Observations in one commercial pulpwood storage yard also showed very little deterioration of wood after 4 to 5 months' storage in late winter and spring. In fact, sprouting of pine from adventitious buds was common in material 4 to 5 months old. Very likely some as yet undetermined weather factor caused this lack of deterioration.

Prevention and Control of Water-Conducting Rot in Buildings

There are two important water-conducting fungi in the South--*Poria incrassata* and *Merulius lacrymans*. These rots must have moist wood to initiate an attack, but under favorable conditions they can extend "aqueducts" from moist wood into wood otherwise too dry to permit a successful attack. Prevention of attack requires use of uninfected dry lumber (below 20 percent moisture), preservative treatment of any wood in contact with the soil or with basement floors, removal of

concrete-form lumber and any wooden debris in crawl spaces, adequate soil drainage under or near the house, no dirt-filled porches, soil covering where basementless houses suffer from condensation, and moisture-proofing where a groundline concrete slab is used.

Once water-conducting rots are established, they can be controlled if all sources of and connections with moisture are found and eliminated. This is a job for an expert, since many links with water are difficult to detect. Occasional Paper 133 reports more fully on research findings.

FOREST ECONOMICS

Forest Survey

Louisiana: Resurvey Field Work Completed

Field work on the reinventory of Louisiana's forest resources was completed in early October. A canvass of forest industries and other timber users was finished in December; the object was to determine the amount of timber cut in the State during 1953. This is the second forest survey of Louisiana, the first having been made in 1934-35.

Compilation of the data is proceeding on schedule and a statistical report will be published in the spring of 1955. It will include estimates of Louisiana's present forest area, timber volume, growth, and cut. It will also note changes that have taken place since the first survey.

The generous assistance of a number of private companies, individuals, and public agencies made it possible to complete the field work well ahead of the schedule that could have been maintained with regularly allotted funds. The total value of cooperation received was $96,000, and this powerfully supplemented Federal funds. Contributions were in the form of manpower, cash, equipment use, and aerial photography. Cash contributions were received into a cooperative account administered by the Louisiana Forestry Commission.

In addition to the Louisiana Forestry Commission, the cooperators included the Gaylord Container Corporation, International Paper Company, Central Louisiana Electric Company, J. A. Bentley Lumber Company, The Brown Paper Mill Company, Inc., The Crossett Company, Southern Advance Bag and Paper Company, A. J. Hodges Industries, Inc., Frost Lumber Industries of Olin-Mathieson Chemical Corporation, Louisiana Power and Light Company, American Creosote Works, Inc., Frank W. Bennett and Associates, Crosby Chemicals, Inc., First National Bank of De Ridder, Guaranty Bank and Trust Company of Alexandria, Hillyer-Deutsch-Edwards, Inc., The Long-Bell Lumber Company, Rathborne Land and Lumber Company, Inc., Union Producing Company, Louisiana Wildlife and Fisheries Commission, United States Air Force, United States Coast Guard, and General Air Transport, Inc.

As soon as they became available, preliminary estimates of forest area and timber volume in the various parishes were released to cooperators.

During the final days of field work, a 4-day test was made of the feasibility of helicopters for transporting the 2-man field teams. In rough going in the north Delta the helicopters doubled the rate of work at no increase in cost. In average conditions, two-way radio communication, modification of procedures to use one-man teams, and a high degree of organization probably would be required to use this form of transport efficiently.

Texas: Resurvey Field Work 56 Percent Completed

Reinventory field work was resumed in east Texas in September. Thirteen of the 36 counties there had been surveyed in 1953 (in cooperation with the Texas Forest Service) to provide a basis for Timber Resource Review estimates. Since resumption of work, the Champion Paper and Fibre Company has given cooperative assistance in Montgomery and Polk Counties. Reinventory field work is now 56 percent done, and should be completed late in 1955.

Alabama's Forest Industry a Leading Source of Income

Information on Alabama's forest industry and timber products output in 1951 was published in Forest Survey Release 74.

Forest industries are a leading source of income in the State. In value added by manufacture, they are outranked only by metal industries and textiles. Conversion of raw timber products into finished items furnishes a livelihood to one in every five persons employed in Alabama's manufacturing industries.

Alabama produces about one-quarter of the yearly lumber cut in the seven States which compose Southern Station territory. Sawlogs, pulpwood, and fuelwood together account for 90 percent of the State's timber output. Sawlogs make up three-fifths of the softwood volume and nearly half of the hardwood. Other products include logs and bolts for veneer and cooperage, poles and piling, mine timbers, and fence posts.

A survey of old-growth longleaf and slash pine stumps indicates that Alabama's supply of resinous stumpwood totals some 10 million tons. Wood naval stores industries have removed about 162,000 tons annually since 1946. If this rate of use continues, the remaining tonnage will be enough for many more years of operation. Detailed regional data

on Alabama's stumpwood supply will be found in the September 1954 issue of Naval Stores Review.

Work was initiated on a comprehensive analysis of the State's forest resource and industry. The final draft should be ready for review during the summer.

Arkansas

A first draft was completed for the analytical report on Arkansas' forest resources and industries. It is planned that the final draft will be ready for review in late spring, and publication is hoped for around the end of the year.

Tennessee

At year's end, the comprehensive analytical report on Tennessee was in final form and ready for early publication by the U. S. Government Printing Office. It will be Forest Resource Report No. 9. Material was supplied to Region 8 for a popular condensation of this report. Prospects are bright for early preparation and publication.

1953 Pulpwood Production Reaches New High

Pulpwood production in the whole South moved to another new high in 1953--16,127,000 cords, or one and a half million cords more than in 1952. Georgia again led with a harvest of 2,879,000 cords; Mississippi was second with 1,923,000 cords; Alabama third with 1,765,000 cords; and Florida fourth with 1,675,000 cords.

The total U. S. pulpwood cut in 1953 was 26 million cords, of which the South produced 61 percent.

The 1953 pulpwood harvest in Southern Station territory was 7,330,000 cords, 8 percent more than in 1952. Pine accounted for 84 percent of the 1953 cut or 6,157,000 cords. Hardwoods made up 16 percent, or 1,173,000 cords.

Six new southern pulp mills went into production in the South during 1954--at Calhoun, Tennessee; Evadale, Texas; Jesup, Rome, and Valdosta, Georgia; and Perry, Florida.

Detailed information on the South's 1953 pulpwood cut was published in the Southeastern Forest Experiment Station's Forest Survey

Release 43. The Southern Station and the Southern Pulpwood Conservation Association cooperated in collecting and compiling the data.

Timber Resource Review Progresses

During most of the year, a major part of the time and effort of Forest Survey personnel was spent in preparing estimates for the national Timber Resource Review.

For Task VI, regional and state estimates of forest area, timber volume, growth, and mortality were prepared for the seven States in Southern Station territory. Forest Survey inventories made in Mississippi in 1947-48, in Tennessee in 1948-50, and in Arkansas in 1948-51 were brought up to January 1953. The Alabama reinventory made in 1951-53 was used without modification. Resurvey field inventory data obtained in 1953 for about two-thirds of Louisiana and one-third of east Texas were expanded to provide January 1953 estimates of forest area and timber volume in these two States. An estimate of forest area in east Oklahoma was derived from aerial photos, and volume estimates were based on modification of earlier survey data in accordance with the current showing in adjacent areas in Arkansas and Texas.

For Task VII, growth estimates made for the 1945 Reappraisal were adjusted to current standards, and trends of net annual growth for the period 1952-2000 were calculated for the Southeast and West Gulf regions.

For Task VIII, field data on the productivity of recently cut land were compiled for the seven States in Southern Station territory and for Arizona and New Mexico. The basic field data for the Timber Resource Review were collected by Regions 3 and 8 and their cooperators, and final tables were prepared by the Regions.

Material assistance was also given on other Timber Resource Review tasks.

Economics of Forest Management

Guides to Profitable Forest Management

A draft of the proposed Technical Bulletin, "Financial maturity--a guide to profitable timber growing," was prepared for publication during the year, and is now in final review.

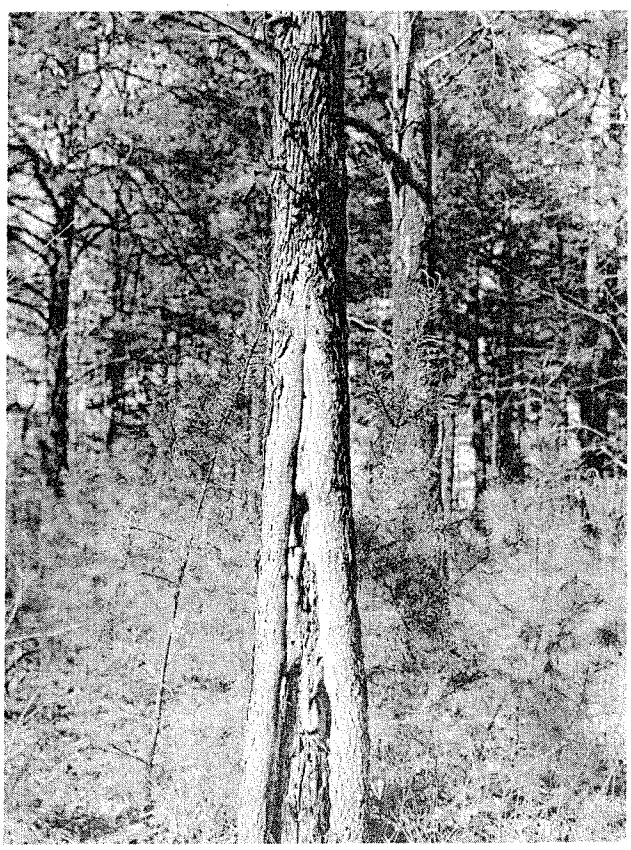
Analysis of 243 advertised pine sawtimber sales from the National Forests in the Coastal Plain of Mississippi, Louisiana, and Texas indicated that the determinants of market price among these widely dispersed units were essentially the same. Though the stumpage was not sold by grade, purchasers tended to recognize differences in timber quality by paying a premium for it. Too, the more bids that were received, the higher the sale price. The number of bids tended to increase with the total volume of pine offered and with its concentration (in terms of cut per acre); in contrast, bids became fewer as the ratio of hardwood to pine volume rose.

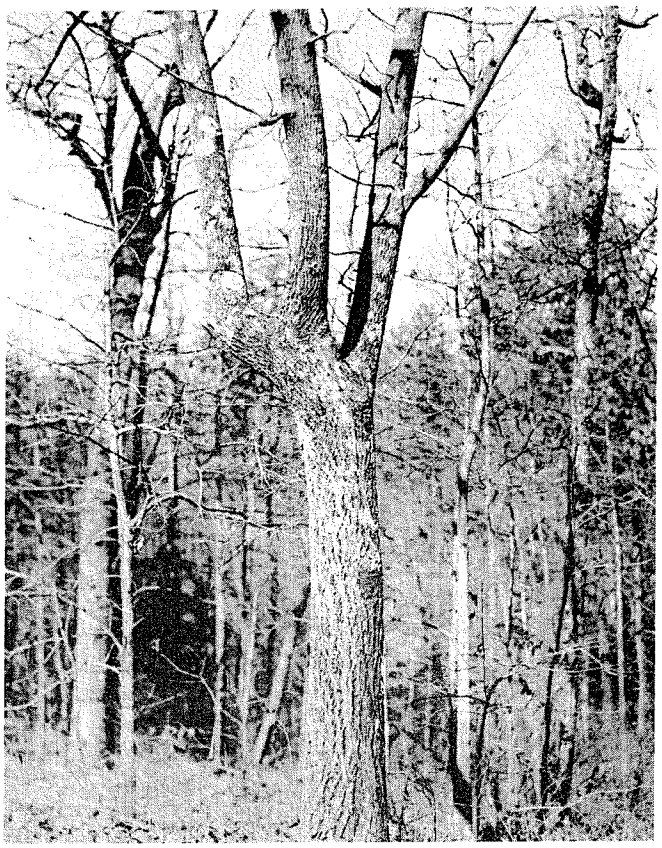
These findings probably apply, in some degree, to private forest managers who obtain competitive bids for their timber offerings. Though these points are not particularly new, the study brings objective evidence to bear on various hypotheses concerning stumpage price differences. It is planned to publish the results of the analysis during 1955.

During the recent Forest Survey of Alabama, timber in the Birmingham area was classified from the standpoint of both grower and user. The survey showed that the area is low in volume and high in number of cull hardwoods, and that small trees predominate. The average good-tree volume per forest acre is only 403 cubic feet, or about 5-1/2 cords. In terms of tree size, three-fourths of the pine sawtimber is in trees 14 inches d. b. h. or smaller, and 70 percent of the hardwood sawtimber in trees 16 inches or less. Almost every third hardwood tree is a cull (fig. 14).

Of the non-cull volume in these sparse stands, 23 percent is in trees that should be removed for the benefit of the stand--either because they are poorly spaced, of low vigor, or otherwise impaired for growing stock. Marketing such trees is no particular problem, since from the timber user's standpoint their quality is equal to that of the desirable growing stock.

Figure 14.--Above: At first glance a respectable stand of hardwood timber. Below: A close look shows that every third tree is a rotten or a rough cull.





Returns From Well-Managed Commercial Forests

At the Crossett Research Center, twenty-four 40-acre compartments have been managed as a commercial forest since 1937. Preliminary analysis of the first 15-year results shows that the initial growing stock of 4,800 board feet per acre (International rule, 1/4-inch kerf, trees 11.5 inches d.b.h. and larger) has increased to 7,200. During the same time, 3,518 board feet per acre of pine logs and 5.6 cords of pulpwood were harvested. Stand structure has improved; there are now considerably more 12-20 inch trees than when the study began. The accumulated records of growth, harvests, costs, and returns are being prepared for publication as a Technical Bulletin.

The East Gulfcoast Research Center is managing 641 acres of second-growth longleaf pine as an investment forest. When the study was established in 1948, the tract was thinly stocked and low-quality pines and scrub hardwoods occupied many acres. To put the forest in shape to grow more and better trees and to produce current revenue, trees ripe for the ax are marked on a portion of the tract each year and sold for the products bringing the best prices. To build up the growing stock, the volume harvested is kept less than the growth; and part of the timber receipts are used for planting, hardwood control, and other cultural practices to put idle acres to work. Pine stocking has increased and tree quality improved, but there is still a long way to go. Intensive management has cost about 43 cents per acre each year. Net revenues have been almost 3 times cash outlays. Gross stumpage receipts are bound to rise sharply as growing stock increases, but management costs are expected to stay about the same.

Returns From Well-Managed Small Tracts

Farm forestry projects at the Gulfcoast Research Center and the Alexandria Research Center were closed during 1954 because of program changes. Projects were continued at six other research centers. As usual, hundreds of visitors attended the annual field days held in cooperation with the various State Extension Services and other agencies. At most research centers, participants in these field days are shown the year's harvest of forest products massed at the roadside. During tours of the woods from which the products are taken, money returns, cash costs, labor requirements, and necessary forest practices are explained.

Though enjoying the common bond of service to farmers, the projects vary greatly. On some, growing stock is sufficient for annual cuts. On others, the harvests must be made at longer intervals. Several Forties depend on natural regeneration; on the rest, planting is neces-

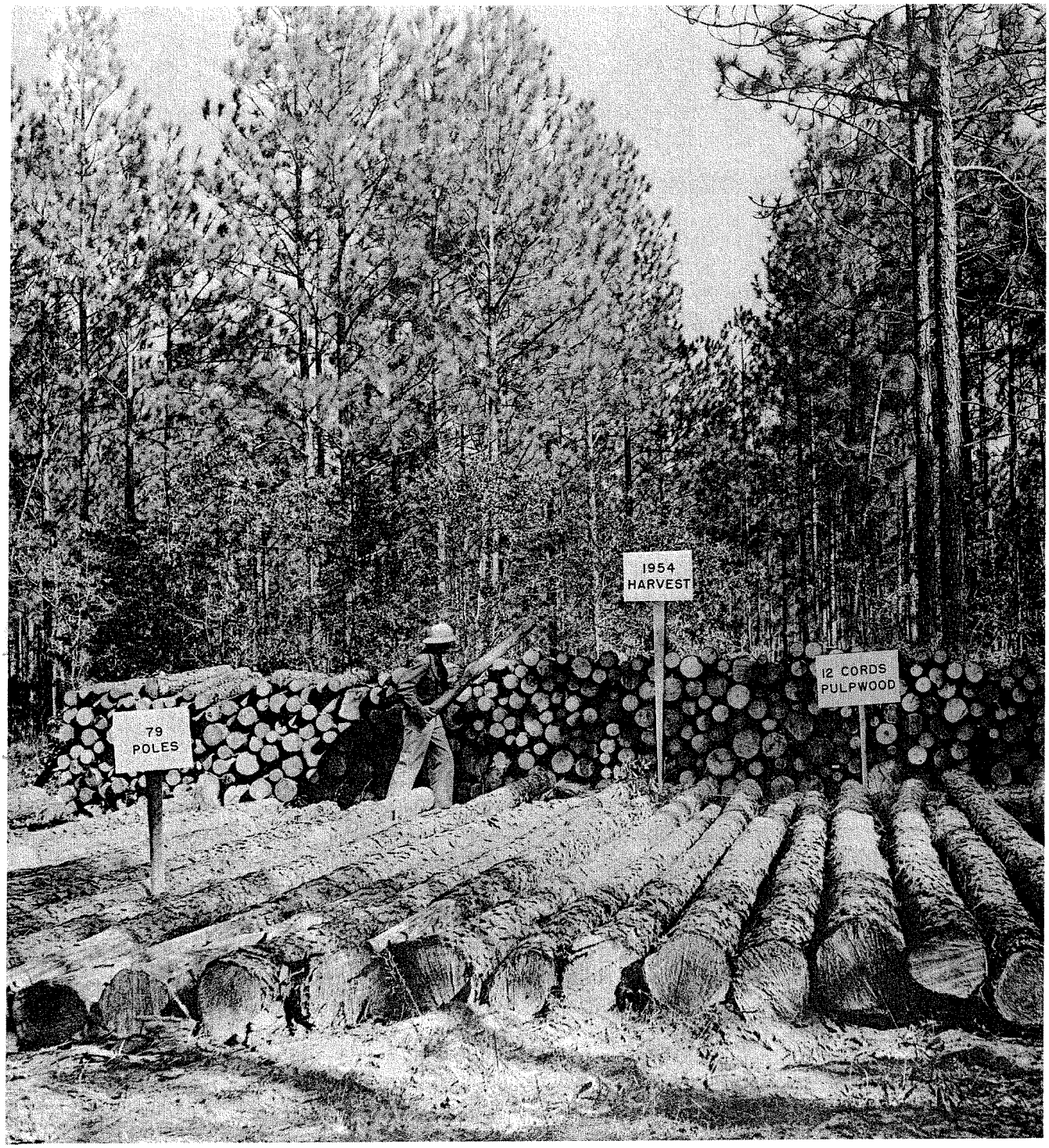


Figure 15. --As visitors see it on the field day: one year's harvest from the longleaf pine farm forty in south Alabama.

sary to put understocked areas to work quickly. Both pines and hardwoods are included in these management tests. These variations result from a deliberate attempt to make each project fit the conditions and needs of the territory it serves.

At the Birmingham Research Center, the seventh annual harvest has been taken from the two farm forties. The 1954 crop from the moderately stocked forty was 53 board feet (International rule) of pine and hardwood sawlogs and 40 cubic feet of mine props per acre. These products were worth $1.75 per acre as stumpage, or $9.41 delivered to market. The poorly stocked forty yielded 11 board feet of sawlogs and 8 cubic feet of mine props per acre, nearly all from low-grade hardwoods. The per-acre value of these products was $0.22 on the stump, or $1.76 at the market. In addition, cutting and delivering the products provided an outlet for 5.4 man-hours of labor per acre on the good unit and 1.1 man-hours per acre on the poor tract.

At the Central Ozarks Research Center, costs of harvesting redcedar trees and value of primary products delivered to markets were calculated by tree size for post- and sawlog-quality trees. In general, trees below 6 inches d.b.h. were of post quality and had 7 to 16 feet of merchantable length. Most trees over 6 inches yielded a combination of sawlogs and posts and had 20 or more feet of merchantable length. Harvesting costs and value of delivered products are summarized in table 11.

Table 11.--Values and production costs for eastern redcedar trees in the Arkansas Ozarks

D.b.h. (inches)	Post trees		Sawlog trees	
	Delivered value	Production cost	Delivered value	Production cost
	- - - - - - - - Dollars - - - - - - - -			
3	0.14	0.11	...	...
4	.21	.16	...	...
5	.30	.22	...	...
6	.42	.31	0.91	0.53
7	.57	.43	1.15	.64
8	.74	.57	1.41	.77
9	...	...	1.70	.90
10	...	...	1.98	1.08
11	...	...	2.30	1.25
12	...	...	2.60	1.42

Because of the small size of redcedar posts and sawlogs, farmers can readily cut and deliver them to market without specialized equipment or hired labor. Another good Ozark farm woodland crop is stavebolts. White oaks nearly cull for other purposes often will yield one or more blocks containing stavebolts worth about one dollar apiece. Stavebolts also can be handled with ordinary farm equipment (fig. 16).

At the Crossett Research Center the seventeenth annual cut was taken from the good forty. A total of 23,265 board feet (International rule) of pine logs and 9.02 cords of pulpwood were removed. These products were worth $668 in the standing tree, or nearly $17 per acre.

This year's cut from the poor forty came to 11,058 board feet of sawlogs and 7.11 cords of pine pulpwood. The stumpage value was $304, or nearly $9 per acre. With this year's cut, the accumulated sawlog harvest from the poor forty exceeds the volume of sawtimber on the area when the study began. On the good forty, this point was reached last year.

Figure 16.--Stavebolts worth about one dollar each can be readily produced from Ozark farm woodlands.

The East Gulfcoast Research Center has intensively managed an understocked longleaf pine forty for seven years. Volume and quality of merchantable timber have been improved, and eighteen acres of scrub oak have been regenerated to stands of longleaf pine seedlings. Poles and pulpwood worth $150 on the stump and $332 delivered to market were cut this year. With management expenses deducted, the net stumpage returns for the first seven years average $3.57 per acre each year. Management during the period required 89 man-hours of labor.

The study has shown that a farmer can profitably handle longleaf pine as an annual crop. Of course, he need not harvest each year--it may be better to cut every fifth year or so. Similarly, there is a choice between selling standing timber or cutting and delivering products. At current high stumpage prices, many will find it best to sell marked timber. Others, especially if they are equipped for the job, will prefer to do their own harvesting and sell their products to a mill.

At the East Texas Research Center, farm forestry has been studied since 1948 on a tract containing 5 thirteen-acre compartments. To provide an annual income, one compartment is cut each year. The compartment first operated in 1949 was cut for the second time in 1954. Between harvests, the pine volume per acre on the compartment increased from 3,702 board feet (International rule) to 4,804. The 1954 crop totaled 11,673 board feet of sawlogs. About four-fifths of the pine growth that accrued during the 5-year period was cut, leaving one-fifth to increase future growth.

To date the tract has produced $1,621 of stumpage--an average of $3.02 per acre each year. Deducting taxes and other management costs leaves an annual net return to the landowner of $2.81. This modest net return can be expected to rise as growing stock and growth increase from current low levels to the amount that the land can most profitably carry.

A study of small woodland ownerships is being made in Nacogdoches County, Texas. Sixteen small woodlands were recently examined to determine the degree of timber stocking. Eight of these were carefully selected tracts which their owners had placed under management in the last few years. The other eight were randomly chosen and presumed not to be managed.

The managed tracts averaged over twice as much basal area and over three times as much cubic- and board-foot volume per acre as the random selections. Of course, the unmanaged tracts have exceedingly

low stocking, and even the managed ones are still a long way from a full stand. Additional data on these tracts, and on small woodlands in the county as a whole, will be published during 1955.

At the Tallahatchie Research Center, three forties of badly depleted second-growth shortleaf pine and upland hardwoods are being rebuilt to good stocking under different intensities of management.

To date all merchantable overburden has been removed from all tracts through a tie and timber sale. On the most intensively managed forty, dry ridges have been fully planted to loblolly pine, while other sites have been interplanted to loblolly and to yellow-poplar. The planted seedlings have been released and the crop trees pruned. On the tract under medium management, about 30 acres have been either fully planted to loblolly pine or interplanted with yellow-poplar and loblolly. All seedlings have been released. On the tract under low-level management, culls 10 inches d. b. h. and larger have been girdled.

FOREST INSECTS

The need for effective and economical methods of reducing the great amount of damage caused by forest insects is constantly increasing as forestry practices become more intensive. Timber owners and land managers are becoming more aware of their losses and many of them are applying such preventive and control measures as are available.

There is still a great need for more complete information about the biology and habits of most of our southern forest insects. A good beginning has been made with some of the bark beetles and the insects that attack forest products, but many others have received very little attention. There is, therefore, urgent need for expansion of research which will lead to more effective control measures.

Early detection of new infestations is basic to success in preventing large outbreaks and in minimizing control costs. A well-organized and alert detection force is obviously of prime importance in any forest area. Much progress has been made in developing an effective detection program in the southern states and this work will be continued and expanded as rapidly as possible.

Using standard forms prepared and distributed by the Forest Insect Laboratory at Gulfport (Mississippi), Federal, State, and private agencies or individuals in 1954 submitted 74 reports of insect infestations. Some of the State forestry departments and larger lumber and pulp companies made aerial surveys of their holdings. Insect Laboratory personnel made two general aerial surveys in Southern Station territory. Information from all sources was correlated at the Laboratory and made available through a new Station publication, the Southern Forest Pest Reporter, of which five issues were distributed in 1954.

Even greater efforts are needed further to speed the detection and reporting of insect infestations by all foresters and others who visit the forest. It is impossible for the Station's insect survey personnel to visit every infestation that is reported, but they make it a point to examine all areas that are threatened with serious losses and to recommend control measures where needed. To strengthen cooperative detection, Station entomologists have conducted training schools for acquainting foresters and other woods workers with the major forest pests in Texas, Oklahoma, Arkansas, and Louisiana. Plans are made for similar training in Alabama and Mississippi in 1955.

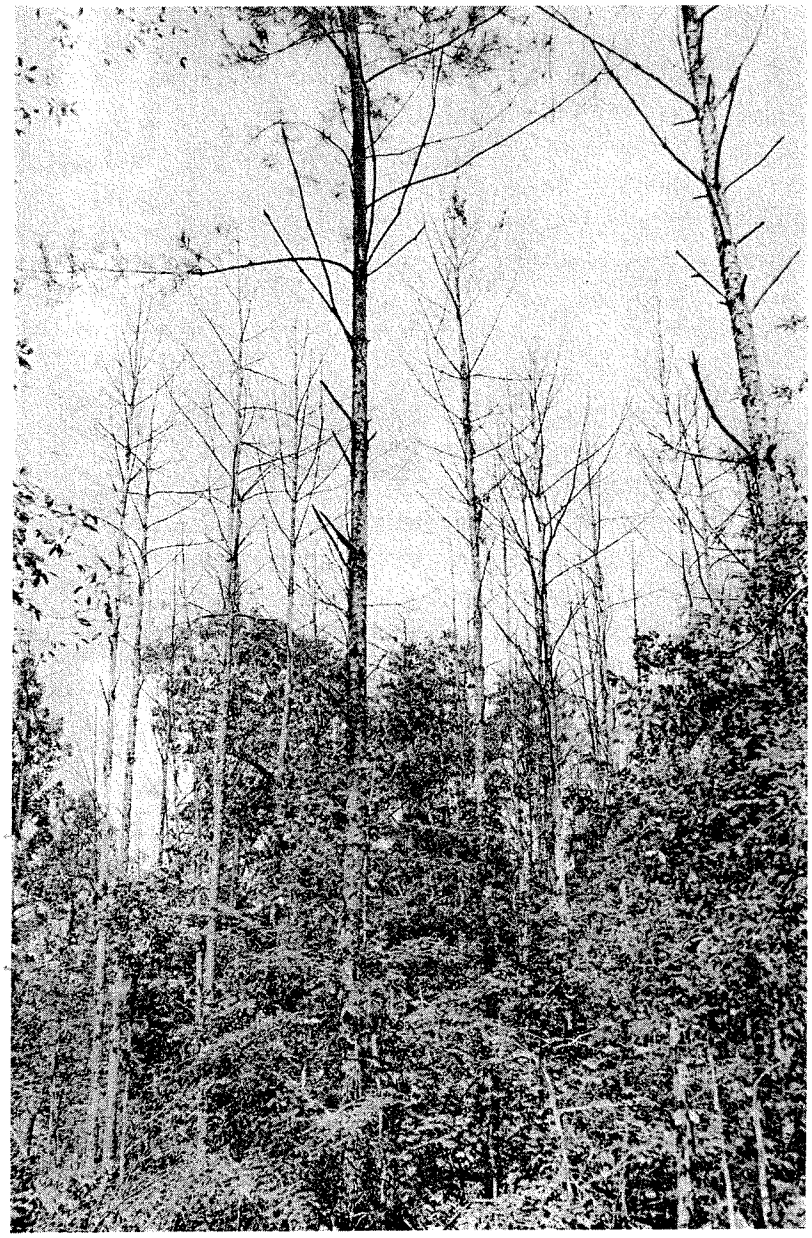


Figure 17. --A stand of loblolly pine killed by the southern pine beetle.

Information about specific insects obtained from surveys and research studies in 1954 is presented below.

Insects Affecting Forest Trees

Southern Pine Beetle Outbreaks Increase in Alabama, Decrease In Mississippi

The southern pine beetle is a major enemy of southern pine forests. When present in endemic numbers, this insect is difficult to locate, but periodically the beetles build up to epidemic numbers within a few months' time. For example, recent outbreaks in eastern Texas and southwestern Mississippi killed about 150 million board feet of pine (fig. 17) before they could be controlled.

Two new outbreaks were discovered in Alabama in 1954. Both of these were on the Talladega National Forest--one on the Oakmulgee Division and the other on the Talladega Division and adjacent private lands. The Oakmulgee outbreak consisted of only two small spots which were readily accessible and were promptly controlled by salvage logging. In the Talladega outbreak, however, there were twenty-three separate infested spots on the national forest and 13 more on adjacent private land. On the national forest and the land owned by the larger companies, beetle-infested timber is being removed by salvage cutting. Efforts are being made to arrange (through provisions of the Forest Pest Control Act) for cooperative control work on the smaller privately owned areas and more inaccessible stands where salvage logging is not practical.

On the Bankhead National Forest in north Alabama, an outbreak discovered in 1953 is continuing but at a much reduced rate in compari-

sonwith its activity during the early months of 1954. There are many small logging operators in the area, and attacked trees have been salvaged rapidly and the developing broods destroyed. In areas not easily accessible, spraying of felled infested trees with an oil solution of benzene hexachloride (as recommended by the Forest Insect Laboratory) has prevented dangerous populations of beetles from developing. It seems likely that these efforts will reduce this infestation to an endemic level during 1955.

Southern pine beetle activity continued in southwest Mississippi, though on a reduced scale and mostly where only a few small spots of infestation existed in 1953. Last summer's cooperative control project was productive. At the year's end, very few spots remained, and evidently little control work will be needed in 1955.

No resurgence of the southern pine beetle in east Texas was observed, despite a very severe and prolonged drought.

In an attempt to determine the underlying causes of the rise and fall of southern pine beetle populations, observations were begun on site conditions, soil moisture, tree moisture, and other factors in areas where outbreaks have just subsided, are apparently at their peak, or are on the upswing. These study areas are in east Texas, southwest Mississippi, Alabama, Tennessee, and North Carolina. It was found that where beetle populations were increasing they were attacking groups of trees that appeared to be healthy except for the effects of drought. In areas where beetle populations were decreasing, most of the infestation was in single trees that had been struck by lightning or otherwise injured.

Young, as well as mature, pine stands were found to be susceptible to attack. Infestations were most prevalent in heavily stocked stands, tending to increase more or less proportionately with increased basal area. Few infestations were found in stands where thinnings or TSI work had been completed in recent years. By reducing competition for moisture and otherwise improving tree vigor, such treatments probably made these stands more resistant to beetle attack.

Browning of the margins of dogwood leaves, premature leaf shedding by oaks, and dying cedar trees were found to be indicators of drought that is severe enough to render pine trees susceptible to attack by the southern pine beetle. On the other hand, beetle outbreaks may die out before the end of a drought period, as has happened in eastern Texas. Further studies are planned to determine why such reductions occur.

Black Turpentine Beetle Remains a Problem in Many Areas

Numerous reports of damage to pine stands by black turpentine beetles were received. Since 1949 the beetle has been a perennial problem in areas that are suffering from drought or have been recently logged. In southwest Mississippi it is causing damage in areas infested recently by the southern pine beetle, and study plots have been established to aid in predicting future intensity of attack in this area.

Studies were also undertaken to develop rules for marking infested trees for salvage cuttings. It was found that the most positive guide is to take those with ambrosia beetle dust at the base. Instances of heavy root attack and light trunk attack were found. Brood was found on large roots near the soil surface. Southern pine beetle epidemics, hail, fire, and logging (especially in dry years) were found to be the principal disturbances favoring turpentine beetle epidemics. Number of attacks was not found to be related to tree diameter. Furthermore, the number of pitch tubes did not indicate the probability of tree mortality, since many of the attacking beetles failed to develop brood.

Information on the habits and control of the beetle will be published in an Occasional Paper in 1955.

Ips Engraver Beetle Damage Widespread as a Result of Drought

The three southern species of Ips bark beetles caused heavy mortality of pine trees in the Deep South during 1954. Undoubtedly this was a result of prevailing drought over most of the area. Since attack by these beetles occurs in scattered single trees or small groups of trees over wide areas, control by salvage or spraying is not often practical. Some landowners are minimizing their losses and preventing build-up of huge beetle populations by employing small mobile salvage crews whose sole task is removing Ips-killed or attacked trees.

A small-scale study in east Texas suggested that spraying the scorched base of fire-damaged trees with benzene hexachloride in diesel oil may prevent Ips attack. This method may be useful on seed trees or in other areas under intensive management. Further tests are planned.

Pine Cones Protected From Insect Attack

Bimonthly spraying to prevent insect attack of first-year longleaf and slash pine cones at the Southern Institute of Forest Genetics has given good results during the nine months the tests have been in

progress. Cone drop was significantly lower on treated than on untreated trees. Spraying will be continued during the second growing season. The insecticide is benzene hexachloride, applied as suspension or emulsion sprays with a hydraulic sprayer (fig. 18). The tests are being made to find practical methods of protecting seed produced on trees used in genetics research. Further study may show that such methods are practical in protecting cones on seed-orchard trees.

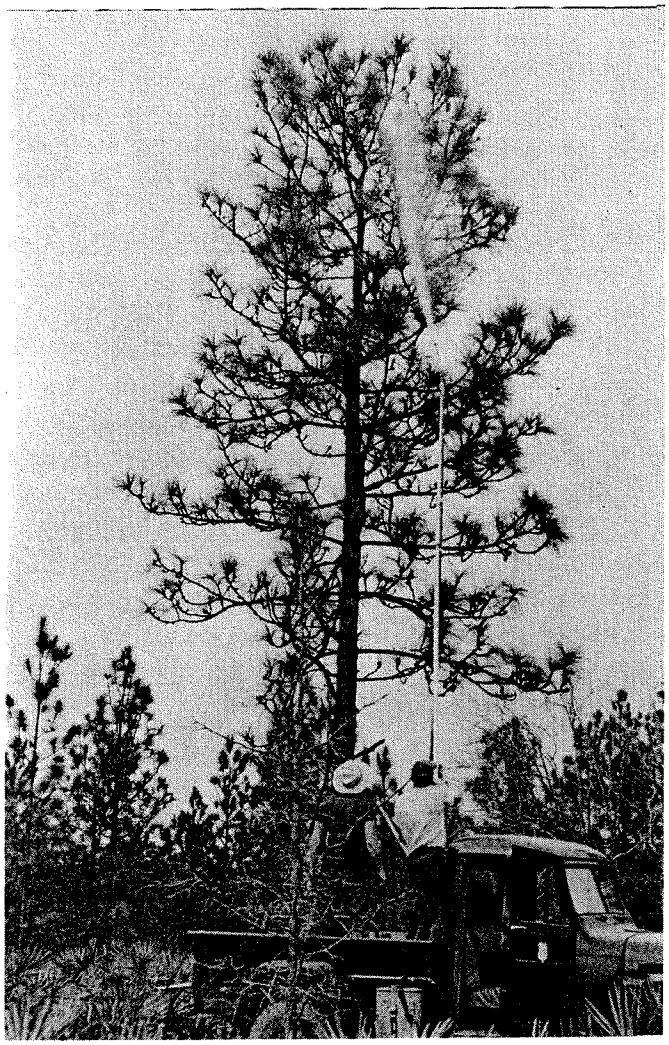


Figure 18.--Bimonthly sprays of benzene hexachloride reduced insect damage to first-year pine cones.

Pine Sawflies at Reduced Intensity

The loblolly sawfly (*Neodiprion* sp.) was observed near Urania, Louisiana, and Hamburg, Arkansas, but not in sufficient numbers to make a control program necessary. In the fall of 1952, approximately 70,000 acres of shortleaf pine in southern Alabama were heavily defoliated by sawflies (*Neodiprion exitans*), but no defoliation has been observed or reported since then. The red-headed pine sawfly was locally important in east Texas in two- and three-year-old loblolly pine plantations. It caused loss of height growth and killed some trees.

Pales Weevil Widespread in Young Plantations

The pales weevil seriously damaged planted pines near Nacogdoches, Texas, and Crossett, Arkansas. Scattered reports concerning this insect were received from Mississippi and Louisiana. The weevils breed in stumps of freshly cut pines. When the new adults emerge they feed on the bark of pine seedlings in the vicinity. The insect is becoming increasingly important in pine areas planted after clear-cutting operations or wild fires. Further research on both chemical and silvicultural control of this insect is much needed.

Leaf-cutting Ant Active in Texas and Louisiana

The leaf-cutting ant, *Atta texana*, caused serious damage to pine plantations in east Texas and southwest Louisiana, often killing as much as 90 to 100 percent of the seedlings on localized areas around each nest or colony. Reports from many sources in these areas attest to its importance in plantations and also in young natural reproduction. Fumigation of the colonies with methyl bromide during the winter months is necessary before infested areas can be planted successfully.

Cypress Looper at Low Ebb

The cypress looper, which in 1953 defoliated about 600 acres of young pond cypress near Alexandria, Louisiana, did not cause noticeable defoliation in 1954. Apparently, natural factors caused its decline.

Forest Tent Caterpillar Defoliation Heavy

An aerial survey in May revealed that the forest tent caterpillar had defoliated approximately 60,000 acres of bottomland gum in the lower Alabama River area and about 1,200 acres on the Calcasieu River in Louisiana. Later in the year, the trees in both areas refoliated to the extent that no outward effect of the spring feeding was noticeable. Undoubtedly the trees suffered a reduction in rate of growth, but investigations are needed to determine the amount of loss caused by such defoliation.

Studies of Borers and Other Hardwood Insects Begun in Mississippi Delta

One of the most important problems affecting the utilization and management of bottomland hardwood stands is the large amount of defective timber encountered during manufacture. Much of this defect is the result of boring and feeding by various insects. The tunnels and scars left in the living trees by such insects often greatly reduce the grade or quality of lumber cut from the trees. The insect channels also provide entry for decay, which increases the amount of loss. Certain other insects, such as the ambrosia beetles, attack dying trees or freshly cut logs and make them practically valueless for anything except low-grade products. Hardwood insects have received very little study in past years.

In recognition of the potentially great increase in value of southern hardwood stands which will be possible if insect damage can be reduced, intensive studies of bottomland hardwood insects were begun

late in the year at the Delta Research Center. This project will include studies of the various species of insects to associate them with the type of damage they cause, to determine their life histories, to define possible relationships between site conditions and insect attack, and to develop silvicultural or other methods of prevention and control.

Insects Affecting Forest Products

Lyctus Powder-post Beetles Can Be Controlled

Lyctus powder-post beetles frequently damage seasoned hardwood lumber, the interior woodwork of buildings, and furniture, tool handles, pallets, tent stakes, and many other stored hardwood products. The ring-porous woods are especially subject to attack. The annual losses in the United States run into hundreds of thousands of dollars.

In laboratory tests on dry lumber, DDT, toxaphene, chlordane, and benzene hexachloride have proven highly effective in preventing Lyctus attack. Lumber dipped for 3 minutes in cold solutions of 5 percent DDT, 5 percent toxaphene, 2 percent chlordane, or 0.5 percent of the gamma isomer of benzene hexachloride in No. 2 fuel oil has not been attacked during the six-year period of the tests. These treatments also kill active infestations of the beetles.

Dipping green hardwood lumber for 10 seconds in cold-water emulsions containing either 5 percent DDT or 0.5 percent of the gamma isomer of benzene hexachloride has prevented attack by Lyctus for five years in laboratory tests. Since these emulsions can be applied in combination with commonly used sapstain preventives, one dip immediately after sawing will protect hardwood lumber against both stain and beetles during normal storage. Both the oil solutions and emulsions are surface treatments only. Another treatment is needed after planing or finishing operations.

Where dipping is impractical, stored uninfested products can be protected with repeated aerosol applications. Ten percent DDT plus 2 percent lindane in oil solution, at a dosage of one-half gallon per 100,000 cubic feet of warehouse space, has been very effective in preliminary tests. Six to eight foggings during the period of beetle emergence prevented attack. The treatment is effective only with items that are loosely piled. The small amount of insecticide deposited by an aerosol does not have much effect on larvae within the wood, but it kills the adult beetles that have emerged or are about to emerge from the wood.

A paper on methods for the prevention and control of damage by Lyctus beetles will be published in the Southern Lumberman for March 15, 1955.

Water Emulsions of Insecticides Give Promising Results Against Bark Beetles on Yard-stored Pulpwood

Ips bark beetles attack freshly cut pine pulpwood. When the wood is placed in storage, serious losses occur as a result of decay, much of which is introduced by these beetles.

Tests have shown that stored pulpwood that has been thoroughly sprayed with an oil solution containing 0.25 percent of the gamma isomer of benzene hexachloride will not be infested by Ips bark beetles. However, this treatment is somewhat expensive, and it is also considered a fire hazard when used in pulpwood storage yards. Attempts were therefore made during the summer of 1954 to develop more economical formulations and practical methods of application.

Water emulsions of benzene hexachloride showed considerable promise in earlier tests against bark beetles under normal populations of the insects. Since the emulsions are far less expensive than oil solutions and do not cause a serious fire hazard, they were tried in both large-scale operational tests and in smaller studies. The work was done at Bogalusa, Louisiana, in cooperation with the Gaylord Container Corporation. All of the tests were located in a pulpwood storage yard with an overwhelming population of Ips bark beetles.

Mill-run wood handled by the usual mill procedures was used for the operational tests. It had been cut several days or even weeks before it arrived at the storage yard and was already heavily infested with Ips. Under such handling practices chemical treatment to prevent additional beetle attack was found to be of little, if any, value. These operational tests emphasize the fact that if beetle attack is to be avoided, handling procedures must be changed. The bolts must be either treated in the woods immediately after cutting or gotten to the storage yard in time to be treated before attack occurs.

In one series of tests, water emulsions containing one or two pounds of gamma isomer of benzene hexachloride or 2 pounds of dieldrin per 50 gallons of emulsion were sprayed on small stacks of freshly cut wood. The stacks were sprayed as thoroughly as practical with a power hydraulic sprayer. Each formulation was applied at the rate of 6 gallons per cord. Both chemicals reduced beetle attack somewhat, but neither was satisfactory.

In another series of small-scale tests, emulsions containing either one pound of benzene hexachloride or one pound of dieldrin per 50 gallons were applied by dipping. Six months later, there was an average of 5.3 beetle holes per square foot of bark on the bolts treated with benzene hexachloride and 7.6 holes per square foot for those dipped in dieldrin. In contrast, there were 61.9 holes per square foot in the untreated check samples. These results are encouraging but not adequate, since even a light infestation of beetles allows the entrance of enough decay to cause heavy damage. Further research with water emulsions is warranted. Heavier concentrations of the insecticides should be tested. Also, so-called "extenders," which have proven of value in increasing the effectiveness of insecticides in other fields of investigation, should be tested in an attempt to develop satisfactory chemical formulations for protection against Ips. The apparent superiority of dip applications over sprays should be verified.

Soil Poisons Can Control Subterranean Termites

Annual losses caused by subterranean termites in the United States are conservatively estimated at 80 million dollars. Although these insects are widely distributed in this country, a high percentage of the loss occurs in the warmer southern states. Since 1946 the testing of chemicals for use as soil poisons has been one of the major projects at the Station's Forest Insect Laboratory at Gulfport, Mississippi. The tests are being conducted in cooperation with the U. S. Army, Corps of Engineers.

One series of tests simulates the application of chemicals to the surface of the soil prior to pouring concrete slab foundations for buildings (fig. 19). Several formulations, all applied at the rate of one pint per square foot of soil surface, have proved highly effective. A concentration of 0.8 percent of the gamma isomer of benzene hexachloride in No. 2 fuel oil or in water emulsion is still giving complete protection after 6 years. Chlordane at a 2-percent concentration in No. 2 fuel oil or in water emulsion is also still effective after 6 years. Five percent DDT in No. 2 fuel oil is 80 percent effective after 7 years. Dieldrin in water emulsion at concentrations of 0.25, 0.5 and 1.0 percent is still giving complete protection after 5 years. Toxaphene, 8 percent in No. 2 fuel oil, has lasted 6 years.

Another phase of this project is the standard stake tests (fig. 20). These simulate, in certain respects, the trench treatment of buildings. Benzene hexachloride, 0.8 percent gamma isomer in No. 2 fuel oil, applied at the rate of 2-1/2 gallons per 10 cubic feet of soil, is still

Figure 19.--Poisoning the soil before pouring concrete slab floors prevents damage by subterranean termites.

giving 100 percent protection after 8 years (fig. 21). DDT, 8 percent in No. 2 fuel oil, at 2-1/2 gallons per 10 cubic feet, gave 100 percent protection for 5 years and is 90 percent effective after 10 years. Sodium arsenite, 10 percent in water, applied at the rate of 4 gallons per 10 cubic feet, has given complete protection in tests which have been in progress in Mississippi for 6 years; and it has been highly effective in the Canal Zone for 9 years. All of these chemicals are superior to formulations recommended in past years.

Papers entitled "Soil Poisons Under Concrete Slabs" and "Termite Control in Slab Construction" appeared in Pest Control magazine for February 1954. A summary of the results of a large series of soil poison tests was issued by the Station under the title "Effectiveness of Soil Poisons in Controlling Subterranean Termites."

Expansion Joint Fillers for Concrete Slabs Show Promise

For many years coal tar pitch has been recommended and used as an expansion joint filler in concrete floors of buildings. However, this product eventually hardens and cracks, allowing termites to enter. There is a need for joint fillers which will not be penetrated by termites and which will remain stable and tightly bonded to concrete surfaces under extreme atmospheric temperatures. One product, an asphaltic battery sealer, appears to possess these properties. It has not been penetrated by termites during a 3-year laboratory test, and it appears to have the desired bonding qualities. It should be tested under actual building conditions before it is definitely recommended.

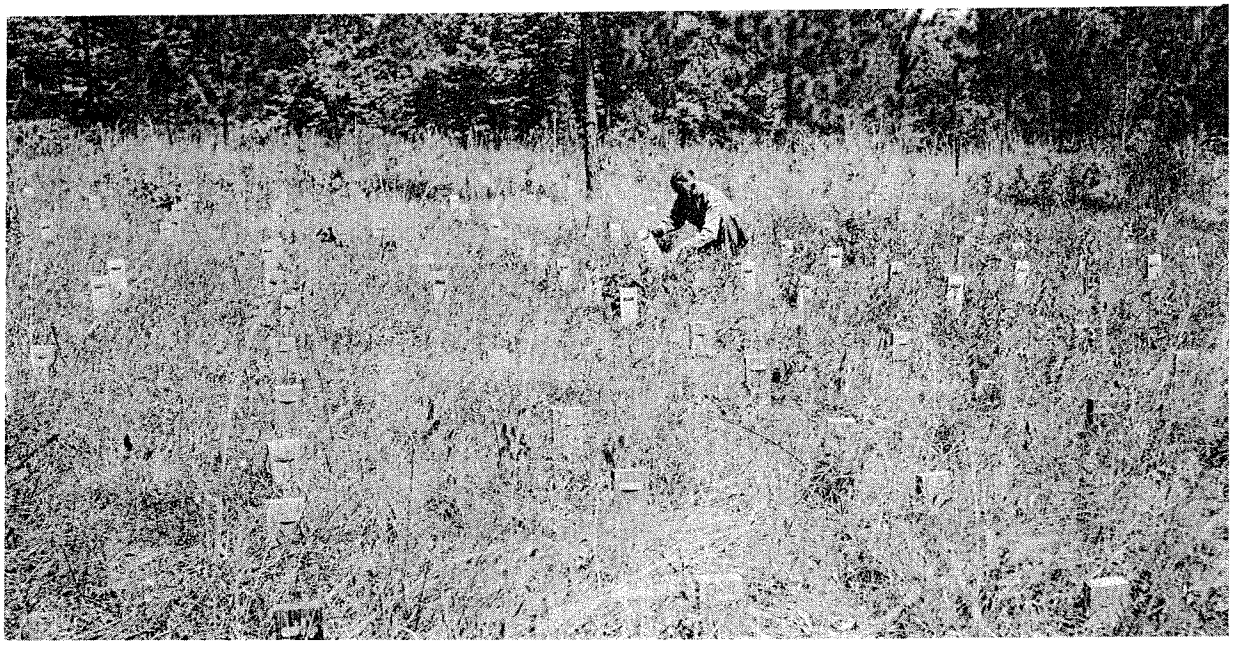
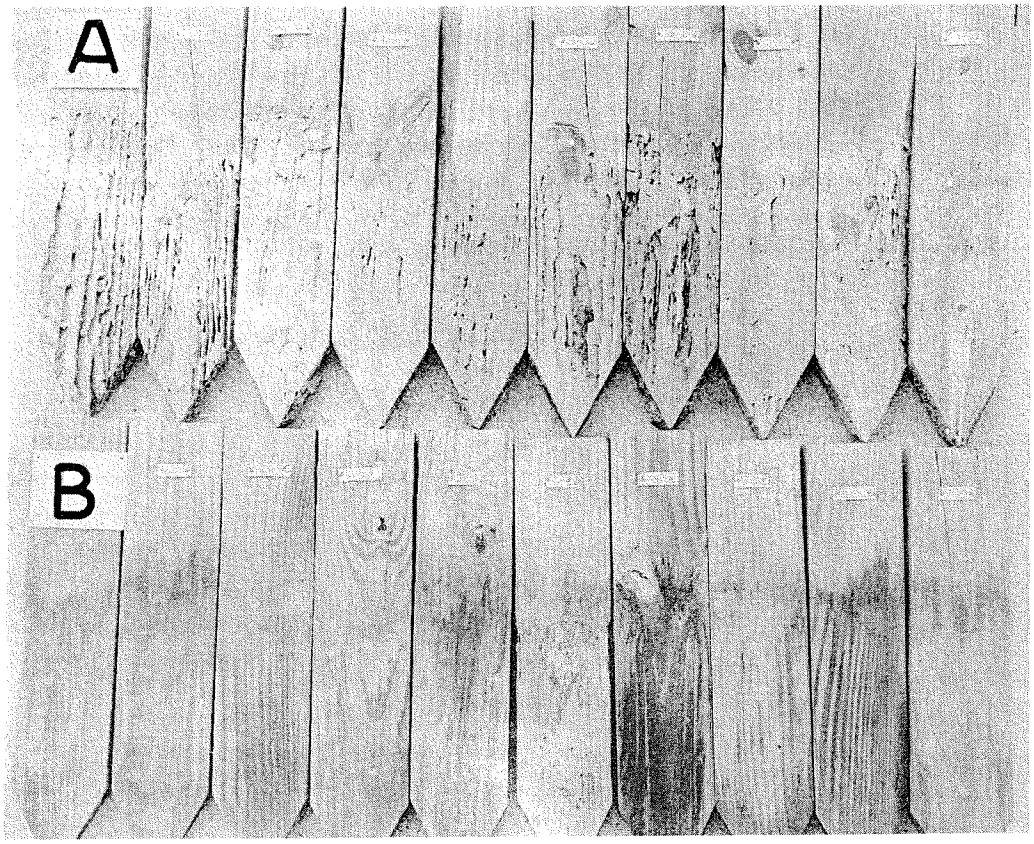


Figure 20. --A standard stake test for evaluating soil poisons. The method involves removing 2 cubic feet of soil from a hole 15 inches in diameter and 19 inches deep, treating the soil with the chemical under test, and replacing it in the hole. A 2 x 4 pine sapwood stake is then driven into the center of the backfilled hole in such a way that termites must cross or penetrate the treated soil before they can attack the stake.

Figure 21. --Some results of a stake test. Upper set of stakes (A), placed in untreated soil, was severely damaged by termites within one year. Lower set (B), placed in soil treated with benzene hexachloride in oil 8 years ago, was not damaged.



Protecting Cellulose Products From Termites

In 1948, samples of various building insulation materials were placed in field tests to determine their resistance to attack by subterranean termites. A product known as Duriscol, which is made of wood chips coated and bonded together with Portland cement, has been very resistant during the six years it has been in test. Tectum, a product made of excelsior bonded together with an inorganic cement, is also resistant. No termite damage of any consequence has occurred after six years on samples of wallboards given 10-second dips in 10 percent sodium arsenite in water, 5 percent pentachlorophenol in oil, or 2 percent copper naphthenate in oil; untreated samples were severely damaged within one year. This project is being expanded to include several new materials.

Resistance of Wire Insulation to Termites

Subterranean termites will penetrate many kinds of underground electrical insulation, thus allowing moisture to enter and causing short circuits and failure of power. The problem is of concern to the Department of Defense as well as to private industry.

A few kinds of insulating materials were placed in soil burial tests in 1949 in Mississippi in cooperation with the U. S. Army, Corps of Engineers. One product, Alpeth Cable, submitted by Bell Telephone, has not been penetrated by termites after about 5 years.

This project was expanded recently when a large variety of insulation materials were placed in test in Mississippi. Tests of these materials will be replicated in the Canal Zone early in 1955. All of these new tests are in cooperation with the U. S. Navy, Bureau of Yards and Docks.

FOREST UTILIZATION SERVICE

Southern forest industry today faces the problem of providing a better product for a more competitive market from a lower-quality raw material that is increasingly expensive to convert. Future maintenance or expansion of the forest products market depends on a continuing close-working relationship between industry and research. This joint effort must equal and exceed today's movement toward the use of alternate materials.

Research has ready answers for many of the problems confronting industry. The Southern Station, through its Forest Utilization Service, serves to combine this scientific knowledge with the hard-earned "know-how" of industry. Maintaining a close relationship with the U. S. Forest Products Laboratory at Madison, Wisconsin, enables this Division to provide industry with the latest research information, and, conversely, to advise the Laboratory on concurrent research needs in the South.

During the past year, 49 research projects were submitted to the Forest Products Laboratory; 38 have been incorporated into the Laboratory's program, bringing the total to nearly 200 investigations of current interest to southern industry. The profitable utilization of waste materials, strength tests of the increasingly available second-growth raw material, cheaper and better ways of preservation, the production of specific kinds of wood for specific purposes, more efficient manufacturing methods--all these are represented in today's utilization research, and results must be disseminated promptly to those who need them most. Demand for this service more than warranted the addition of a second technician to the staff of the Division during the year.

Utilization of Heavy Wood Waste Expands

Bark removal machinery has implemented the conversion of heavy sawmill waste (slabs and edgings) into pulp chips. Early research at the Southern Station on the yield of pulp chips from southern pine logs is still used by industry to locate promising sites for new installations. Today at least 34 mechanical sawlog barkers, together with the necessary chippers and other equipment, are operating in the South. Of these, 20 are large models, suitable for handling up to 2,000 logs per day. Four-

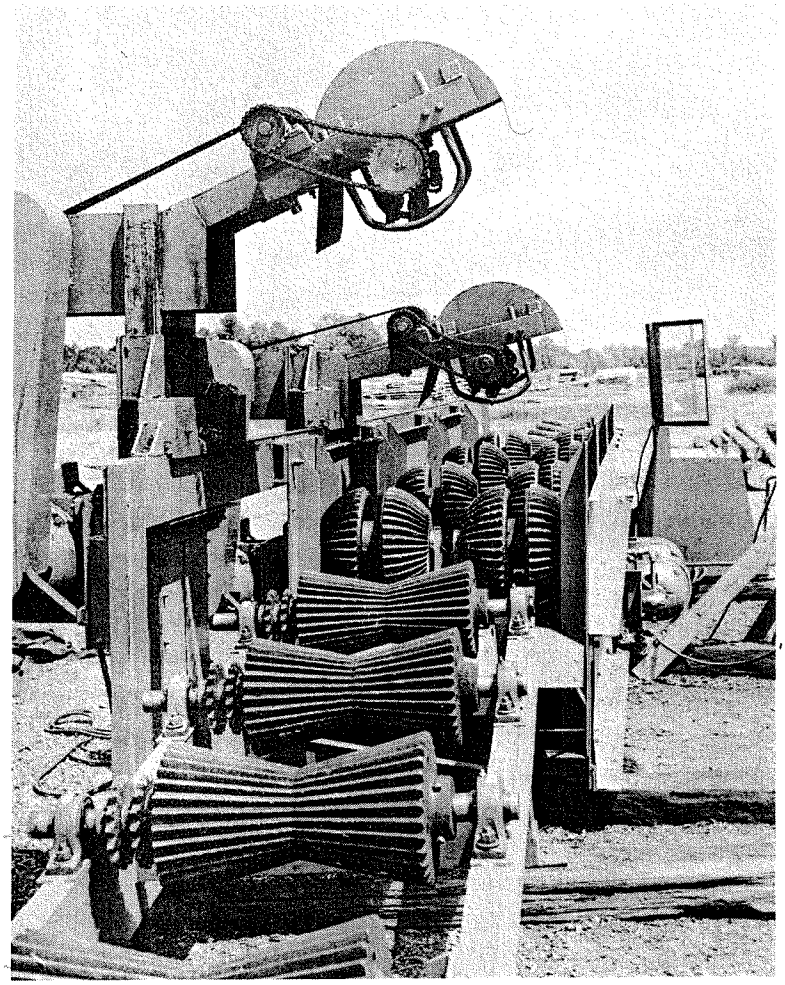


Figure 22.--This double-headed chain-flail barker is capable of serving sawmills cutting up to 30 MBF of pine sawlogs per day. Twelve machines of this type are operating in the South.

Table 12.--Estimated supply of heavy waste now available annually at southern sawmills

Sawmill class (annual production)	Mills	Total production	Production of heavy waste: Per M lumber tally 1/	Production of heavy waste: Total 2/
	Number	Billion bd. ft.	Pounds	Cords
Large (10,000 MBF and over)	100	1.7	1,081	782,000
Medium-large (3,000 to 10,000 MBF)	600	3.0	1,151	1,470,000
Medium (500 to 3,000 MBF)	3,500	7.5	1,151	4,875,000
Sub total	4,200	12.2	...	7,127,000
Small (Less than 500 MBF)	20,000	2.5	1,527	1,623,000
Total	24,200	14.7	...	8,750,000

1/ Difference in converting factors is due to higher percentage of small logs cut by smaller mills. Small logs yield more heavy waste.

2/ 4,700 pounds of green chips equal 1 cord.

teen are smaller machines, designed for mills cutting up to 30 M per day. Nineteen more barkers, including 2 large hydraulic ones, are now being installed.

Waste wood chips are usually sold either by weight, cubic-foot volume, or cord equivalent. In general, values run from $11.00 to $13.00 per cord.

From Southern Station conversion factors, it appears that the South's 24,000 sawmills annually produce almost 9 million cords of heavy waste. Of this amount, 6 million cords are pine. Table 12 shows the distribution of waste by mill-size classes.

Many of the large and medium-large mills are already tooling up to tap this source of additional income. The immediate challenge to research lies in utilizing the large supply of heavy waste at the medium and small mills. Here large barkers are not justified, but small sawlog barkers, slab barkers, slab concentration yards, and chip-bark separators offer promising lines of investigation.

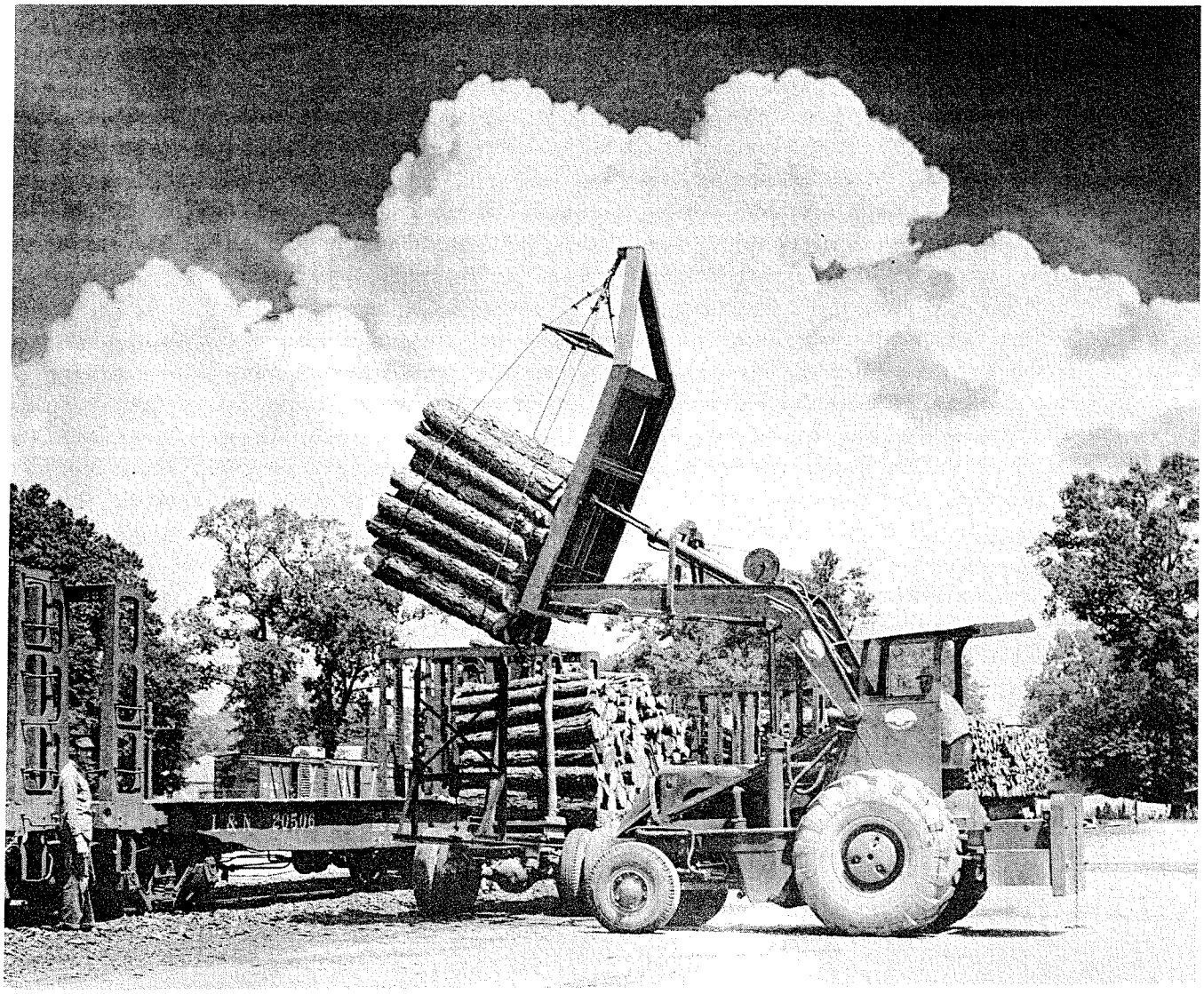
The demand for pulpwood in the South has increased from 6 million cords in 1943 to 16 million cords in 1953. With this rapid expansion, it is estimated that the production of pulp and paper will almost double in the next 20 years. If the anticipated demand develops, a greater part of this sawmill waste

will be needed, and economical methods must be worked out to utilize a higher proportion of this potential supply.

Producing More Pulp Per Acre

The Forest Products Laboratory has determined that southern pine pulpwood of high specific gravity can yield 50 percent more pulp than wood that is low in specific gravity. Laboratory personnel are now undertaking the coordination of a South-wide study, in cooperation with the Station, to determine the factors of growth, site, and heredity which govern the formation of high specific gravity wood in the tree. When silviculturists are provided with this information, they will be able to treat their forest lands to produce the highest per-acre yield of the ultimate product.

Figure 23.--The South now produces over half of the nation's pulpwood. Mechanization makes this possible.



Predicting the Lumber Yield of Sawlogs

In modern sawmilling, the adequate prediction of lumber yield from sawlogs can make or break an operation.

At the Delta Research Center, the standard Forest Service Hardwood Log Grades were applied to logs cut from a depleted stand of Delta timber. One hundred and fifty-five Nuttall and overcup oak logs were graded first in the standing tree and later on the deck.

Log buyers from 4 types of operations inspected the logs as grouped by grades and evaluated them for their particular use. A complete report, covering lumber out-turn by grade, comparison of grading in the tree and on the deck, and other related data, will be published.

Lumber yield grades have also been developed for southern pine logs. These are receiving thorough regionwide tests. In cooperation with the Forest Utilization Section of the Tennessee Valley Authority, a check of the Forest Service Interim Southern Pine Log Grades was made on shortleaf pine in north Alabama. Over 700 sawlogs were graded and the grade yield of lumber recorded.

Considerable checking is still necessary before both industry and research will be satisfied that these grades are adequate for all species of southern pine in all parts of the region.

Strength Tests for Poles

Southern pine, source of most of the nation's poles, is included in the pole-testing program being conducted by the Forest Products Laboratory in cooperation with the American Society for Testing Materials. Poles from the main United States sources of supply are to be tested for strength, both green and after preservative treatment. Strength will be evaluated not only by small "clear sample" methods, but also by two "full-length" procedures. From these tests, revised fiber-strength specifications may lead to more efficient use of available poles. Shortleaf and loblolly have been shipped to the Laboratory from the Kisatchie National Forest. Longleaf and slash poles have been supplied from the Southeastern Forest Experiment Station's area.

Figure 24. --Sample shortleaf pine poles for the nationwide strength tests being carried on at the Forest Products Laboratory, in cooperation with the American Society for Testing Materials.

Strength Tests for Second-Growth Pine

Almost all strength data on southern pine have been determined from old-growth wood. So that timber design engineers can use proper values as second-growth wood comes into greater production, the Forest Products Laboratory has begun extensive tests of the new material. Preliminary results show no large differences between old and second growth.

In 1954, the collection of shortleaf and loblolly pine samples from various regions was completed. The samples showed an interesting range in specific gravity, which is closely correlated with strength. For the central Alabama area, specific gravity of shortleaf pine ranged between .41 and .52 and averaged .47. In the Ouachita Mountain area of Arkansas, specific gravity of second-growth shortleaf pine averaged .48, close to that of all shortleaf tested. Second-growth loblolly pine from southeast Arkansas had specific gravity of .49, also very close to the average for this species.

Newsprint from Cottonwood and Willow

The Laboratory has demonstrated that newsprint can be manufactured from cottonwood and willow grown in the Mississippi Delta. Groundwood, chemi-groundwood, cold soda, and sulfite semichemical pulps were made from cottonwood, and groundwood pulp was made from willow. In several combinations these pulps produced newsprint paper of good strength and brightness.

Studies in the use of southern woods for various types of paper are continuing. Tremendous quantities of surplus hardwoods are available in southern forests. When industry is ready to utilize this vast supply, research will have the fundamental processes ready for development.

Reducing Warp in Second-Growth Southern Pine Lumber

Whenever wood of varying density is enclosed in a single piece of lumber, warp and crook is a constant manufacturing problem. During drying, variable shrinkage stresses are set up and the lumber usually becomes distorted. One thousand board feet of southern pine 2 x 4's and 1 x 6's, having varying amounts of warp and twist, were shipped to the Laboratory for a study of the utility of high-frequency heating in straightening and stabilizing and thus increasing the utilization and value of crooked lumber.

Controlling Stain in Red Oak Flooring

The amount of stain occurring in red oak lumber and flooring has increased alarmingly during the last year, even in lumber dipped in anti-stain chemicals. At times, the stain does not appear until after the product is dressed and ready for sale. Samples from ten sawmills indicate that most of the stain is caused by fungi. In some samples, however, the discoloration was more in the nature of chemical stain. Cooperative studies are under way to determine what causes the stain and to develop remedial measures.

Accelerated Kiln Drying

In working toward the reduction of seasoning costs, the Laboratory is experimenting with accelerated kiln-drying schedules. One series of tests involves high initial kiln temperatures followed by

lowered final temperatures. Another series is studying the effect of intermittent steaming. The wood being dried is 8/4 tupelo.

There is increased demand for thin flooring and panelling. To meet this need, drying stresses in red oak and accelerated drying of thin (1/2-inch) oak are also under investigation.

Advice and Guidance to Wood Users

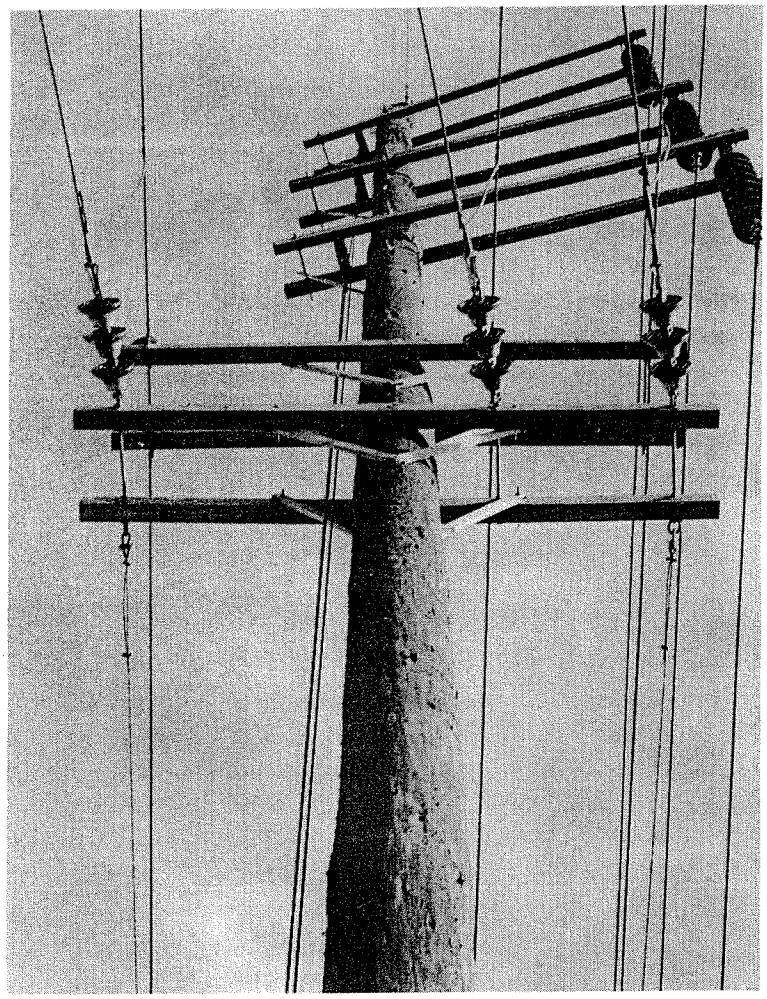
Advice and guidance to manufacturers and users of wood products constitutes a major responsibility of the Forest Utilization Service. In 1954 over 150 direct contacts with firms and individuals were made in connection with wood utilization problems. A few of the representative activities in this phase of the work are listed below.

Assistance to private companies:

The Bernard and Singer Lumber Companies of New Orleans in determining cause of and remedial measures for buckling of oak block flooring laid on concrete slabs. The range of local relative humidity leads to unstable moisture content (with consequent shrinking and swelling) in the flooring. Studies leading to increased dimensional stability and improved laying practices have been proposed to the Laboratory so that this expanding flooring market for the extremely large volume of low-grade oak may be sustained.

The New Orleans Public Service in determining the cause of serious twist and cross-arm deflection in poles installed in their high transmission lines. Hundred-foot poles have twisted as much as 20 degrees. The

Figure 25.--In-service top twist of high line transmission pole as shown by cross-arm deflection. Such twist seems to occur when poles with spiral grain are installed before they have reached equilibrium moisture content.



company is seeking preventive specifications for new high-cost urban installations.

Todd Johnson Dry Docks at New Orleans on decay and termite damage to floating dry docks. Entomologists have recorded this as one of the few occurrences of subterranean termites at sea.

Assistance to public agencies:

U. S. Army Port of Embarkation on the preservative treatment of wood used in blocking and storing Army vessels.

U. S. Customs on the identification and classification of imported woods, for tariff purposes.

U. S. Army, Corps of Engineers, on the preservative treatment of wood, the identification of timbers used in construction, and the detection of embedded metal in timber salvaged from military ranges.

The Federal Housing Authority on the suitability of and specifications for hardwood piling as a substitute for pine in foundation construction in the New Orleans area.

RANGE MANAGEMENT RESEARCH

Grazing Management of Forest Range

Cutover longleaf pine lands are being used increasingly for timber growing coordinated with cattle grazing. Such use has met with difficult range problems, particularly in the desirable intensity of grazing and the possible place of prescribed burning. To get at these problems, an intensive study of cattle grazing, burning, and tree growth was started in a series of test paddocks on cutover forest in central Louisiana in 1952.

Preliminary results indicate that, to prevent the build-up of an undesirable grass rough, slender bluestem ranges apparently need to be grazed to about 60 percent of the annual growth. A greater degree of grazing may cause excessive mortality of planted pine seedlings.

In 1954 the moderately grazed paddocks were utilized 64 percent and the heavily grazed 73 percent. Planted slash pine after 3 years had 95 percent survival in the ungrazed paddocks, 85 percent in the moderately grazed, and 76 percent on the heavily grazed. Results with planted longleaf are not yet available.

In the 12 grazed paddocks, grass yield in 1954 was in excess of 3,000 pounds, air-dry, per acre. The 6 ungrazed paddocks, with accumulated slender bluestem rough, produced 30 percent less grass than grazed paddocks.

An alternate means of removing excess grass rough is through prescribed burning, which is scheduled for application on certain of the experimental paddocks in 1955.

In the major range management study at Alexandria, a prescribed-burning program was initiated in each of three 580-acre pastures. The objectives of burning were: (1) to control hardwood brush invasion on certain areas, (2) to reduce the highly hazardous roughs which had built up in previous years on slender bluestem range, and (3) to increase the forage value of the range by removal of the heavy grass rough.

The prescribed burns in 1954 gave fair control of scrub oaks--small sprouts up to 5 feet high were killed back. A distinct improvement in forage conditions resulted, with some indication that periodic burning may permit a relative increase in pinehill bluestem and related good forage grasses after removal of the slender bluestem rough. Cattle

that grazed on May burns made better weight gains than those on areas burned in March. In all the pastures, the prescribed burns enabled the cattle to attain better condition by fall than in any previous year.

Forest Grazing Prevalent in East Texas

Some 82 percent of the forest land in east Texas is grazed by cattle, according to information gathered in 13 sample counties in 1953 by the Forest Survey in cooperation with the Texas Forest Service. The counties were Angelina, Bowie, Cherokee, Liberty, Marion, Nacogdoches, Newton, Orange, Rusk, Titus, Tyler, Upshur, and Walker. In these counties, 770 forest locations, with 2 one-acre plots per location, were classified as grazed or ungrazed. The classification was based on such evidence as grazed vegetation, cattle droppings, and cattle trails or tracks.

In the longleaf-slash pine area of 239,000 acres, 94 percent of the sample areas were grazed. In the loblolly-shortleaf pine and oak-pine types, totalling 2,804,500 acres, 81 percent of the plots were grazed. In the hardwood types, with 1,522,300 acres, 82 percent of the plots were grazed.

The study did not show the intensity of grazing but it did indicate a widespread use of forest range in east Texas.

The forest grazing problems in 11 southeast Texas counties were determined in a study recently completed by the Texas Forest Service and Agricultural Experiment Station, assisted by the Southern Station. Complete dependence on forest range for yearlong forage is decreasing in this area largely as a result of overgrazing and deterioration of switch cane and bottomland forage formerly used for wintering cattle. The most important range cattle management problem in the area sampled is lack of adequate year-round forage and supplements. Overgrazing and browsing appear to have prevented pine restocking only on rather small areas.

Range Management Important After Hardwood Control

Hardwood control studies on forest range have now progressed to the point where consideration must be given to grazing management of areas where low-value hardwoods have been poisoned or otherwise removed.

Grass makes a quick upsurge after hardwood control. The increase is often 2- or 3-fold, and reaches maximum in 3 to 4 years. The lush

growth is also of better quality. Cattle graze such areas closely and may trample or browse small pine seedlings unless grazing is restricted. On a three-acre area where hardwoods were controlled in cooperative tests by the Agricultural Research Service, it was necessary to exclude cattle in order to protect planted pines.

Seeded Firebreaks May Improve Livestock Distribution

Seeded firebreak strips established in central Louisiana in 1953 were closely grazed in that year and effectively resisted both head and flank fires on parts of the range which were prescribe-burned in March 1954. The main purpose of the strips was to lead cattle into little-used parts of the range. The strips were prepared by discing, fertilizing, and seeding to carpetgrass and Kobe lespedeza. It is planned to complete the study and report on the results in 1955. The work is in cooperation with the Agricultural Research Service.

Range Forage Quality Studied

Seven years' study of the nutritive values of range forage in central Louisiana strongly indicates that digestible carbohydrate nutrients are slightly deficient on forest range during summer and early fall and very deficient in winter. This finding is based on more than 300 samples of range forage and cattle diet taken from 1944 to 1950 and correlated with animal weight gains and losses. Chemical analyses of these samples were summarized and interpreted in Bulletin 488 of the Louisiana Agricultural Experiment Station. In addition to the carbohydrates, protein and phosphorus are also deficient in fall and winter. Calcium appears to be adequate at all times. It now seems that certain minor minerals may be lacking, and a new study of trace minerals in range forage has been set up in cooperation with the Louisiana Agricultural Experiment Station.

Supplementing Forest Range Forage Increases Weight Gains

In view of the apparent deficiency in digestible nutrients in range forage during much of the year, the Animal Industry Department of Louisiana Agricultural Experiment Station devised a low-cost, high-energy mixed feed for a cooperative study of means of supplementing the diet of cattle on forest range in central Louisiana. Developed mainly from locally grown feeds, the mixture consists of: cane molasses--40 percent, cane bagasse--24 percent, cottonseed meal--14 percent, alfalfa meal--14 percent, bone meal--5 percent, salt and cobalt (tr.)--3 percent.

From July to October 1954, cattle fed about 1 pound per head per day of this feed gained 121 pounds, while animals not fed gained only 65 pounds. Thus the cattle that were fed went into the winter having gained 56 pounds per head more than the unfed group--at a feed cost of $3.66 plus labor. So far this feeding study indicates that range beef cattle can be kept in good condition in summer and early fall by supplemental feeding of about 1 pound per head daily of a low-cost mixed feed. The ration will be increased as needed in winter and continued to about April 1. A similar feeding schedule will be followed from July 1955 to April 1956. It is expected that the beneficial results from the supplemental feed will be measured in terms of increased calf crops and heavier calves in 1956.

Livestock Damage to Tree Reproduction

Many slash pine plantations have been successfully established even though the planted area was grazed by cattle. However, occasional reports of damage to pine seedlings indicate that under certain conditions damage may be serious.

In 1954 a special study of cattle damage was completed on several Louisiana tracts seeded or planted to pine. Where noticeably heavy damage occurred, one or more of the following conditions were found: The seedlings were small, usually under 30 inches high; the areas were overgrazed or heavily trampled; the forage was sparse or very dry; the damage occurred in winter or early spring; and grass growth had been stimulated by the use of fire, hardwood control measures, or similar operations. On planted areas, pine seedling mortality varied from 5 to 20 percent. On direct-seeded areas, where there had been more disturbance of the ground in seedbed preparation, 25 to 90 percent of the seedlings were killed. Seedlings that were moderately browsed but not trampled generally recovered satisfactorily.

If it is impracticable to exclude grazing entirely for 2 or 3 years after planting, the following precautions are recommended to reduce damage: (1) Avoid undue disturbance in preparation of planting site, (2) prevent heavy grazing, (3) inspect seedlings every few weeks to detect and remedy incipient serious damage, and (4) exclude winter grazing for 3 to 4 years if possible.

In a study of hog damage to planted slash pines, it was concluded that young planted slash pine stands can be prescribe-burned safely for reduction of hog damage or hazard reduction if burning conditions are favorable. In February and March 1953, prescribed burns were made

on 600 acres in a 4-year-old plantation in central Louisiana. All fires were set against the wind. Paired plots in burned and unburned areas were established to check damage and mortality from fire and hogs. Although hog rooting was relatively light in 1953, prescribed burning sharply reduced the amount of damage. Hogs damaged or killed 33 percent of the seedlings on unburned plots and less than 5 percent on the burned plots. The fire killed 8 percent of the seedlings. All together only 13 percent of the seedlings were damaged on the burned plots, but height growth on all trees the year after burning averaged 3 inches less than on unburned plots.

Well-timed TSI Can Improve Forage on Deer Range

In a well-managed hardwood or pine-hardwood forest, periodic timber stand improvement on different parts of each management unit should provide a sustained amount of usable deer forage.

Where drastic timber stand improvement treatments were applied in 1953 on the Sylamore District of the Ozark National Forest, the amount of deer forage in the form of sprouts, legumes, and vines was estimated to have increased at least tenfold by 1954.

Other studies of deer browse on the Sylamore from 1945 to 1951 showed that when number of deer was reduced to capacity of the range, the herbage increased in the hardwood-grape-greenbrier, and red cedar-greenbrier types. In the pine-huckleberry type, however, herbage gradually decreased as the overstory timber stand closed in and killed many browse plants. Actual amounts of herbage were considerably less on plots grazed by deer than on protected plots. This indicates incomplete recovery from previous overbrowsing. In general, the herbage decreased as the tree canopy closed over.

Information was obtained on wildlife habitat research problems for the Southern Station territory. The major problems, as listed by the Station's various research centers, are: (1) Effects of timber management practices on big game cover and food production. (2) Deer browsing damage to pine and desirable hardwood reproduction. (3) Livestock-deer relationships on forest range. (4) Erosion-control plantings of legumes and other plants of value as food for game on forest lands.

Plans for studies in this field are to be formulated in 1955.

PUBLICATIONS

Items marked with an asterisk are available on request to the Southern Forest Experiment Station

*Allen, R. M. Increasing the survival of planted longleaf pine seedlings. Proceedings, Third Annual Forestry Symposium, School of Forestry, Louisiana State University, pp. 64-65. [Clipping the needles of longleaf pine planting stock reduces transpiration and usually improves survival. Wax foliage coatings sometimes increase survival and sometimes reduce it.]

*Broadfoot, W. M. Core vs. bulk samples in soil-moisture tension analysis. Occasional Paper 135, pp. 22-25. [At tensions up to 1 atmosphere, bulk samples retain more water than core samples; core samples, representing field conditions, should be used in tension analysis at from 0 to 1 atmosphere.]

*_____ Procedures and equipment for determining soil bulk density. Occasional Paper 135, pp. 2-11. [Describes and compares three methods of determining soil bulk density and discusses relevant sampling equipment.]

*_____ and Raney, W. A. Properties affecting water relations and management of fourteen Mississippi soils. Mississippi Agricultural Experiment Station, Bulletin 521, 18 pp. [Soil texture, plasticity, organic content, pH, bulk density, 1/3- and 15-atmosphere tension values, and infiltration and drying rates.]

Bruce, D. Mortality of longleaf pine seedlings after a winter fire. Jour. Forestry 52: 442-443. June 1954. [Mortality was highest among seedlings that were severely brown-spotted, especially among diseased seedlings that had begun height growth. It seems likely, however, that nearly all of the trees killed by the fire would eventually have succumbed to brown spot.]

*Campbell, R. S. Fire in relation to forest grazing. Unasylva 8: 154-158. Dec. 1954. [In many parts of the world, fire appears to have a definite place in forest and range management. The problem is to eliminate haphazard burning and to apply prescribed, controlled burning where it is needed.]

*Campbell, R. S., and Cassady, J. T. Moisture and protein in forage on Louisiana forest ranges. Jour. Range Mangt. 7: 41-42. January 1954. [On longleaf pine-bluestem ranges, the moisture content of the forage is a ready index to protein content. Mature, dry forage is low in crude protein, while succulent green growth has high protein values.]

*_____, Epps, E. A., Jr., Moreland, C. C., Farr, J. L., and Bonner, F. Nutritive values of native plants on forest range in central Louisiana. Louisiana Agricultural Experiment Station Bulletin 488, 18 pp. [Evaluates the important range forage species at different stages of growth; considers effects of timber type, burning, grazing, and fertilizing on nutrient content of forage; points out deficiencies in cattle diet at various seasons and suggests ways of overcoming them.]

*Carlson, C. A. A core method for determining the amount and extent of small roots. Occasional Paper 135, pp. 43-47. [A method for determining the weight and volume and estimating the aggregate length and surface of small roots (from 0.02 to 2.0 mm. in diameter) in a unit volume of soil.]

*_____Comparison of laboratory and field calibration of fiberglas moisture units. Occasional Paper 135, pp. 34-42. [In comparisons at the Vicksburg Infiltration Project, field calibration was more accurate than laboratory calibration.]

*Cassady, J. T., and Mann, W. F., Jr. The Alexandria Research Center. Southern Forest Experiment Station, 49 pp. [Detailed, illustrated account of the Center's efforts to solve the most urgent land-management problems of the cutover longleaf pine type west of the Mississippi River.]

Coyne, J. F. Destructive insects of southern pine. Forests and People 4 (1): 18-20. First Quarter, 1954. [Damage by, habits of, and control measures for the southern pine beetle and the pine sawfly.]

*Croker, T. Seven years of management on the Escambia Farm Forest Forty. AT-FA Jour. 17(2): 14. November 1954. [In 7 years, this 40-acre tract of longleaf pine has yielded 150 poles, 22 MBF (Doyle) of sawlogs, 56 cords of pulpwood, 24 cords of fuelwood, 380 fence posts, and 21 barrels of gum. Stocking has increased from 3,525 to 3,750 board feet per acre (International rule, 1/4-inch kerf).]

*Southern Forest Experiment Station, 4 pp.

*Croker, T. Trail blazing for longleaf investment owners. Southern Lumberman 189(2369): 167-169. December 15, 1954. [Methods and results of management on the Escambia Investment Forest.]

*Cruikshank, J. W. 1953 pulpwood production in the South. Southeastern Forest Experiment Station Forest Survey Release 43, 34 pp. [Statistics, by state and county, on South's 1953 pulpwood harvest.]

*Derr, H. J., and Mann, W. F., Jr. Future forests by direct seeding. Forests and People 4(4): 22-23, 38-39. Fourth Quarter, 1954. [How two private landowners successfully seeded longleaf pine in central Louisiana.]

*Doss, B. D., and Broadfoot, W. M. Terminal panel for electrical soil-moisture instruments. Occasional Paper 135, pp. 30-31. [Construction details for a terminal panel to facilitate contacts between soil-moisture units and the ohmmeter used to measure resistance.]

Fassnacht, D. L. An old bet pays off. Southern Lumber Jour. 58(1): 24, 78. January 1954. [Pine planting tests carried out in 1936 on the old Choctawhatchee National Forest have given valuable hints on the problems of survival and growth in the sandhills.]

*_____ Preparation of some adverse sites in the Southeast. Proceedings, Third Annual Forestry Symposium, School of Forestry, Louisiana State University, pp. 69-79. [Fire, chemicals, and mechanical means for preparing pine planting sites in the sandhills.]

*Ferguson, E. R., and Duke, W. B. Devices to facilitate King-tube soil-moisture sampling. Occasional Paper 135, pp. 26-29. [Construction details of a measuring trough for dividing soil cores into depth increments, and of a box for storing and carrying soil sample cans.]

*_____ and Stephenson, G. K. Fire effects studied in east Texas. Fire Control Notes 15(3): 30-32. July 1954. [Studies have been initiated to determine the silvicultural and hydrologic aspects of prescribed burning in the upland forests of east Texas.]

*Freese, F. Tree species for planting spoil banks in north Alabama. Tree Planters' Notes No. 17, pp. 15-18. August 1954. [Loblolly pine is a good species for spoil-bank plantings. Sycamore and sweetgum should do well on moist sites.]

*Furnival, G. M. Deadening culls in bottomland hardwood stands. Southern Lumberman 189(2369): 123-124. December 15, 1954. [Results and costs of three successful control methods for bottomland species.]

_____ Study cold-soaking treatment of posts of Delta hardwoods. Mississippi Farm Research 17(8): 5. August 1954. [The study was installed in 1953. The preservative, a 5-percent solution of pentachlorophenol in diesel oil, was absorbed better by some species than by others.]

*Gaines, E. M., Campbell, R. S., and Brasington, J. J. Forage production on longleaf pine lands of southern Alabama. Ecology 35: 59-62. January 1954. [Production of grasses and forbs decreased as the basal area of the tree stand increased. Herbage production also was negatively associated with weight of tree litter.]

Grano, C. X. Re-establishment of shortleaf-loblolly pine under four cutting methods. Jour. Forestry 52: 132-133. February 1954. [The cutting methods, applied in 1937, were single-tree selection at 5-year intervals, seed-tree, and clear-cutting to two diameter limits--6.5 and 11.5 inches. So far, it appears that, with proper hardwood control and an adequate seed source, good reproduction can be obtained with any of the methods.]

*Grosenbaugh, L. R. New tree-measurement concepts: height accumulation, giant tree, taper and shape. Occasional Paper 134, 32 pp. [An entirely new concept of tree measurement that can utilize mark-sensed punched cards of bookkeeping machines more fully than conventional methods and that facilitates breakdown of a tree into grade or use classes. In addition, a unique cumulative table allows calculating conoidal log or tree surface and cubic or International volumes for diameters up to 50 inches and for lengths to 400 feet.]

Guttenberg, S. Growth and mortality in an old-field southern pine stand. Jour. Forestry 52: 166-168. March 1954. [Effects of several cutting treatments on a dense stand of 44-year-old shortleaf and loblolly pine. The stands responded well, even though they were past the age at which the first thinning should have been made.]

Hebb, E. A. How to open pond pine cones. Jour. Forestry 52: 770. October 1954. [A short dip in boiling water opens the cones without injuring the seed.]

Hebb, E. A. Preservative treatment for paperboard seed traps. Jour. Forestry 52: 249. April 1954. [Brush treatments can make these inexpensive traps last for at least two seasons.]

*Henry, B. W. Sporulation by the brown spot fungus on longleaf pine needles. Phytopathology 44: 385-386. July 1954. [In south Mississippi, the light, wind-blown ascospores, by which brown spot chiefly spreads to disease-free stands, were found every month from February 1952 through January 1953. Heretofore it was thought that ascospores are produced only in late winter and early spring.]

*Hopkins, W. Forest research in the longleaf-slash pine belt. Paper read at 1954 meeting of Southern Pine Association, 4 pp. [Federal research on forestry problems of the Coastal Plain from Florida to Texas.]

*_____, and Hebb, E. A. Guide to Chipola Experimental Forest. Southern Forest Experiment Station, 24 pp. [Brief illustrated guidebook to the Chipola Experimental Forest, in the sandhills of western Florida.]

*Huckenpahler, B. J. Poisoning versus girdling to release underplanted pines in north Mississippi. Jour. Forestry 52: 266-268. April 1954. [Single-hack frill girdling gave cheaper and more complete kill than Ammate on upland oaks and hickories. Ammate secured a quicker kill and reduced basal sprouting.]

Johnston, H. R. Results of tests simulating application of soil poisons under concrete slabs. Pest Control 22(2): 24, 28, 46. February 1954. [Preliminary suggestions for spraying termite-control chemicals under existing foundation slabs.]

*King, D. B. Experiment reveals costs of rebuilding farm forest in test on 40-acre plot. Mississippi Farm Research 17(2): 8. February 1954. [For about $4 per acre, including labor, a depleted 40-acre upland forest on the Tallahatchie Experimental Forest in north Mississippi was restored to full stocking.]

*Kowal, R. J. Termite control in slab construction. Pest Control 22(2): 12, 14, 16, 18. Feburary 1954. [A review of the problem, in the hope of stimulating the pest control operators' interest in approaching each job as a research problem in itself and thereby gradually improving the effectiveness of treatment applied.]

*Kowal, R. J. Forest insects and forest insect research in the South. Paper read at 1954 meeting of Southern Pine Association, 9 pp. [Descriptions and habits of insect enemies of southern pine, with particular reference to the underlying causes of epidemics.]

Lee, R. E. Much east Texas damage caused by forest insects in recent years. Texas Forest News 33(4): 5-6. July-August 1954. [Research is seeking ways of preventing insect epidemics.]
Southern Lumberman 190(2370): 54. January 1, 1955.

_____ Skidway inspections aid bark beetle research. Jour. Forestry 52: 767, 770. October 1954. [Incipient epidemics can often be detected by inspecting freshly cut logs at mill yards and skidways and then tracing infested timber to its place of origin in the woods.]

*Lehrbas, M. M. Chip procurement possibilities. Jour. Forest Products Research Society 4(4): 24A-26A. August 1954. [Possibilities and problems of collecting sawmill waste at small and large mills and concentration yards of various kinds.]

*Maisenhelder, L. C. Survey of hardwood planting possibilities in the South. Proceedings, Third Annual Forestry Symposium, School of Forestry, Louisiana State University, pp. 40-47. [In the major stream bottoms of the South, and on upland hardwood areas within the Lower Mississippi Valley and Coastal Plains, about 25 percent of the forest land needs planting, reinforcement planting, or conversion planting. The broad problems have been defined, but specific knowledge is largely lacking.]

Mann, W. F., Jr. Direct seeding research with longleaf, loblolly, and slash pines. Proceedings, Third Annual Forestry Symposium, School of Forestry, Louisiana State University, pp. 9-18. [Tentative recommendations for seeding longleaf and a summary of progress to date on research with slash and loblolly.]

_____ Thinning loblolly pine. Forests and People 4(2): 20-21, 54. Second Quarter, 1954. [A loblolly plantation in central Louisiana was thinned experimentally in 1948, when it was 20 years old. Remeasurements in 1953 showed that unthinned plots had made the best growth. Very heavy thinnings were required to stimulate diameter growth at all, and even stands cut back to 60 square feet of basal area per acre did not achieve a diameter growth rate of 3 inches in 10 years.]

*Mann, W. F., Jr., and Derr, H. J. Direct seeding of southern pines. Southern Lumberman 189(2369): 115-117. December 15, 1954. [It is still too early to recommend direct seeding for general use. This article is intended to guide landowners who want to conduct experimental sowings on their own lands.]

_____, and Derr, H. J. Warn landowners to guard against rabbit damage. Forests and People 4(2): 47. Second quarter, 1954. [If numerous enough, rabbits will cause extensive damage to pine plantations by nipping off seedlings. Spraying seedlings with, or dipping them into, a mixture of asphalt emulsion and copper carbonate will repel the rabbits and prevent damage.]

Mignery, A. L. Better forestry for east Texas bottomlands. Gulf Coast Lumberman 41(23): 4, 46. March 1, 1954. [Two intensities of improvement cutting are being compared with a conventional diameter-limit cutting on an 87-acre tract in the Angelina River bottom.]

*_____ Farm woodland opportunities in the South. Paper read before Association of Southern Agricultural Workers, Dallas, Texas, February 1954. 10 pp. [The farm forestry research program of the Southern Forest Experiment Station.]

*Moyle, R. C., and Zahner, R. Soil moisture as affected by stand conditions. Occasional Paper 137, 14 pp. [This study, made in south Arkansas during 1953, indicated the desirability of methods of stand treatment that will conserve moisture and permit it to be used chiefly by the most useful species.]

*Muntz, H. H. How to grow longleaf pine. Farmers' Bulletin 2061, 25 pp. [Suggestions for establishing and managing longleaf stands.]

*_____ Seventh annual harvest, Birmingham Farm Forestry Forty. Southern Forest Experiment Station, 3 pp. [In 7 years, more than 15 MBM of sawlogs and 10,000 cubic feet of mine props have been cut from this 38-acre tract.]

Peevy, F. A. Woody plant control in southern forests. Proceedings, Seventh Annual Meeting, Southern Weed Conference, pp. 261-264. [Reviews chemical and non-chemical methods of controlling undesirable hardwood trees and brush, and recommends best treatments for various conditions.]

*Reinhart, K. G. Relation of soil bulk density to moisture content as it affects soil-moisture records. Occasional Paper 135, pp. 12-21. [Some of the relationships and difficulties involved in converting soil-moisture content in percent of oven-dry weight to inches depth of water.]

*_____, and Pierce, R. S. Tanks, trafficability and trees. Southern Lumberman 189(2369): 208, 210. December 15, 1954. [Describes soil-moisture and soil-strength studies undertaken by the Vicksburg Infiltration Project for the Corps of Engineers.]

*_____, and Taylor, R. E. Infiltration and available water storage capacity in the soil. Transactions, American Geophysical Union 35: 791-795. October 1954. [Infiltration studies at Vicksburg emphasize the importance of antecedent available storage capacity upon infiltration rates and amounts for certain fine-textured soils.]

*Reynolds, R. R. Forest research is paying dividends. Paper read at 1954 meeting of Southern Pine Association, 4 pp. [". . . In the last 15 years intensive forest practice has proved to be a paying business in the South. . . . We have reached the point now where forest management in the woods has nearly caught up with research, and we must somehow find ways and means of speeding up research."]

*_____Growing stock in the all-aged forest. Jour. Forestry 52: 744-747. October 1954. [With the performance of loblolly pine in southern Arkansas as an example, this article raises some fundamental questions about traditional concepts of all-aged growing stock.]

*_____, and Rawls, I. W. 1954 annual harvest, Farm Forestry Forties, Crossett Experimental Forest. Southern Forest Experiment Station, 4 pp. [Sixteenth annual harvest from the Poor Forty, seventeenth from the Good Forty.]

*Scarbrough, N. M., and Allen, R. M. Better longleaf seedlings from low-density nursery beds. Tree Planters' Notes No. 18, pp. 29-32. [In south Mississippi, longleaf pine planting stock from nursery beds with not more than about 24 seedlings per square foot were larger at lifting time, survived better in the field, and began height growth sooner than seedlings from denser beds.]

*Secrest, H. C. Effectiveness of soil poisons in controlling subterranean termites. Southern Forest Experiment Station, 5 pp. [Summary of studies begun in 1946 at Gulfport, Mississippi.]

Shoulders, E. Timber stand improvement work benefits Ozark hardwood forests. Arkansas Farm Research 3(1): 6. Spring 1954. [Development of stands on Ozark National Forest, following timber stand improvement work carried out in 1934-35.

*Southern Forest Experiment Station. Forest insect conditions in 1953: Alabama, Arkansas, Louisiana, Mississippi, Oklahoma, Texas. Southern Forest Experiment Station, 4 pp. [Resume of the activity of major southern forest insects during 1953.]

_____ Southern Forest Insect and Disease Reporter. 1954.
Issue 1, June. 3 pp.
*Issue 2, July. 3 pp.
*Issue 3, August 13. 3 pp.
*Issue 4, October 15, 4 pp.
*Issue 5, December 30. 2 pp.
[Current reports on forest pests in territory served by the Southern Forest Experiment Station.]

Stephenson, G. K., and Young, D. 1955 pine cone crop should influence forest management. Texas Forest News 33(3): 4, 6, 7. May-June 1954. [Suggestions to Texas landowners for taking advantage of the good pine seed crop anticipated in 1955.]

Sternitzke, H. S. Alabama's stump wood supply. Naval Stores Review 64(6): 17-18. September 1954. [Volume of resinous stumps available for wood naval stores manufacture.]

_____ Gum naval stores in southwest Alabama. AT-FA Journal 16(12): 10. September 1954. [Statistics on turpentined pines in the gum naval stores belt.]

*_____, and Christopher, J. F. Alabama's forest industry. Forest Survey Release 74, 31 pp. [Production statistics, by county, for lumber, pulpwood, and other items. State-wide trends in output of major products.]

Thomas, A. A. To find it--use a pin! Forest Farmer 13(8): 12. May 1954. [Looped wire pins, painted in various colors, can be used to mark the location of pine seedlings that are to be kept under observation.]

*Toole, E. R. Disease problems in hardwood forests of the Lower Mississippi Valley. Southern Lumberman 189(2369): 179-181. December 15, 1954. [Illustrates and describes the rots, cankers, and other diseases important to foresters and lumbermen.]

Toole, E. R. Rot and cankers on oak and honeylocust caused by Poria spiculosa. Jour. Forestry 52: 941-942. December 1954. [The trunk rot typically found behind these cankers was found to be lengthening at the rate of 0.8 foot per year.]

*_____Sweetgum blight--a problem in forest management. Southern Lumberman 189(2362): 35. September 1, 1954. [Summary of current knowledge. Includes data on progress of blight on study plots in Mississippi.]
Mississippi Farm Research 17(6): 8. June 1954.

*_____, and Huckenpahler, B. J. Yellow-poplar dieback. Plant Disease Reporter 38: 786-788. November 15, 1954. [Symptoms and etiology of an apparently new disease of yellow-poplar.]

*Verrall, A. F. Preventing and controlling water-conducting rot in buildings. Occasional Paper 133, 14 pp. [Describes main structural features and conditions associated with attack and suggests measures for prevention and control.]

1/_____, and Teitell, L. Preservative-moisture repellent treatments for wooden ammunition packing boxes. Report R-1213, Frankford Arsenal, Ordnance Corps, U. S. Army. 50 pp. [Technical progress report on extensive tests being conducted in Mississippi, Wisconsin, and the Canal Zone.]

2/Wakeley, P. C. Planting the southern pines. U. S. Dept. Agriculture, Agriculture Monograph 18, 233 pages. [Planting policies, seed, nursery practice, planting, plantation care.]

*_____The growth intercept method of site classification. Proceedings, Third Annual Forestry Symposium, School of Forestry, Louisiana State University, pp. 32-33. [It seems feasible to develop a means of classifying pine planting sites by the length of the "5-year intercepts" as measured on a number of young trees. The 5-year intercept for a tree is the length of trunk it formed (as indicated by the whorls of branches) in 5 consecutive years, in the first of which the tree attained breast height.]

1/ Available only through Frankford Arsenal or the Chief of Ordnance, U. S. Army.

2/ For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. $2.75 per copy.

*Wakeley, P. C. The relation of geographic race to forest tree improvement. Jour. Forestry 52: 653. September 1954. [Brief statement of relation of geographic races, geographic sources of seed, and seed provenance studies to the science of genetics and to silviculture and forest planting in general.]

*_____, and Campbell, T. E. Some new pine pollination techniques. Occasional Paper 136, 13 pp. [Stages in the development of cone flowers; instructions for making pollination bags, disposable pollen extractors, and pollinizers.]

Walker, L. C. Early scrub-oak control helps longleaf pine seedlings. Jour. Forestry 52: 939-940. December 1954. [Planted longleaf seedlings should be released during their first year in the field. Earlier or later release is less beneficial.]

*_____ Release longleaf seedlings early. Southern Lumberman 189 (2369): 169-170. December 15, 1954. [Popular version of Journal of Forestry article.]

Woods, F. W. Sandhills strategy. Pulpwood Production 2(11): 18-20. November 1954. [Describes research on Chipola Experimental Forest.]

*_____, and Hopkins, W. Phone-jack terminals for soil-moisture units. Occasional Paper 135, pp. 32-33. [Phone jacks can be used to make contact between leads of electrical-resistance units and the ohmmeter.]

*Young, G. Y., Toole, E. R., and Berry, F. H. Status of sweetgum blight, 1953. Plant Disease Reporter 38: 93-95. February 15, 1954. [Current knowledge about effects, distribution, and possible causes.]

*Zahner, R. Soil site classification as a guide to plantation survival. Proceedings, Third Annual Forestry Symposium, School of Forestry, Louisiana State University, pp. 25-31. [Outlines soil and topographic conditions that combine to make a site a good or poor risk for forest plantations.]

SOUTHERN FORESTRY NOTES

*No. 89. January 1954.
Alabama's timber resource.--H. S. Sternitzke.
Forests and People 4(2): 53. Second Quarter, 1954.

Count your cottontails. --W. F. Mann, Jr., and H. J. Derr.
Interim log grades for southern pine. --L. R. Grosenbaugh.
Estimating quality of longleaf sites. --D. C. McClurkin.

*No. 90. March 1954.
New light on spread of brown spot. --B. W. Henry.
Forests and People 4(3): 38. Third Quarter, 1954.
Pine stocking rises after hardwood cut. --H. A. Yocom.
Costs of skidding eastern redcedar. --E. Shoulders.
Shade may improve longleaf survival. --R. M. Allen.
Forests and People 4(3): 31. Third Quarter, 1954.
The Unit. News Letter No. 54, p. 6. September 1954.

*No. 91. May 1954.
Cruising efficiency. --C. Mesavage.
Forests and People 4(4): 31. Fourth Quarter, 1954.
Logging costs and mortality in Texas hardwoods. --A. L. Mignery.
Forests and People 5(1): 31. First Quarter, 1955.
How early can longleaf be pruned? --D. Bruce.
Forests and People 5(1): 26. First Quarter, 1955.

*No. 92. July 1954.
Record harvest of southern pulpwood. --J. F. Christopher.
Controlling water-conducting rot. --A. F. Verrall.
Management increases growth rate. --R. R. Reynolds.
Forests and People 4(4): 28. Fourth Quarter, 1954.
Southern Lumberman 189(2362): 52. September 1, 1954.

*No. 93. September 1954.
Killing bottomland culls. --J. S. McKnight and G. M. Furnival.
Southern Lumberman 189(2369): 130. December 15, 1954.
Do birds see red? --H. L. Williston.
Southern Lumberman 189(2369): 117. December 15, 1954.
Forests and People 5(1): 30. First Quarter, 1955.
Forest walls retard young longleaf. --L. C. Walker and V. B. Davis.
Southern Lumberman 189(2369): 126. December 15, 1954.

*No. 94. November 1954.
Machine faster than ax for girdling. --H. A. Yocom.
Karmex W persists in sandhills soils. --F. W. Woods.
Weevil damage on fresh-cut pineland. --E. R. Ferguson and W. B. Duke.
Forests and People 5(1): 30. First Quarter, 1955.
The Unit. News Letter No. 57, p. 2. April 1955.

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