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OCCURRENCE *of* LITTLE LEAF DISEASE *of* PINE *and* ITS EFFECTS *on* FORESTRY *in* ALABAMA

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THE LITTLE LEAF DISEASE of pine is a major problem in the pine forests of the northern half of Alabama.

Pine has long been the major source of lumber in this section. The principal objective of forest management is to maintain these pine forests in a high rate of production. Maintaining pine is not a simple problem. Nature tends to replace pine with hardwoods in the course of time. Pine management is further complicated by the little leaf disease, which threatens to destroy an important part of the pine stand.

In parts of the State, as much as 30 per cent of the pine volume is affected by the disease. Yet some foresters have been slow in recognizing the importance of the little leaf disease. It is important, therefore, to see if the present methods of forest management are the best to use in pine stands where the little leaf disease is present.

In Alabama little leaf is found in practically every county in the Piedmont and Upper Coastal Plain regions, and in the Coosa Valley and along the southern fringe of the Appalachian Mountains (Figure 1). It also occurs throughout the Piedmont of the other Southeastern States, in the northeastern corner of Mississippi, and in Tennessee.

HISTORY OF LITTLE LEAF

Reports of an unhealthy condition of shortleaf pine were made from Alabama in 1934 and 1935.[1] Investigations were made by the Division of Forestry Pathology, U.S. Department of Agriculture; this condition of shortleaf pine was reported as a distinct disease of unknown origin.[2]

[1] Dean D. J. Weddell of the School of Forestry, University of Georgia, formerly with the Alabama Agricultural Experiment Station, was one of the first to report the disease.

[2] Siggers, P. V. and Doak, K. D. 1940. The Little Leaf Disease of Shortleaf Pine. U.S. Forest Service, Southern For. Expt. Sta. Occasional Paper 95. 5 pp.

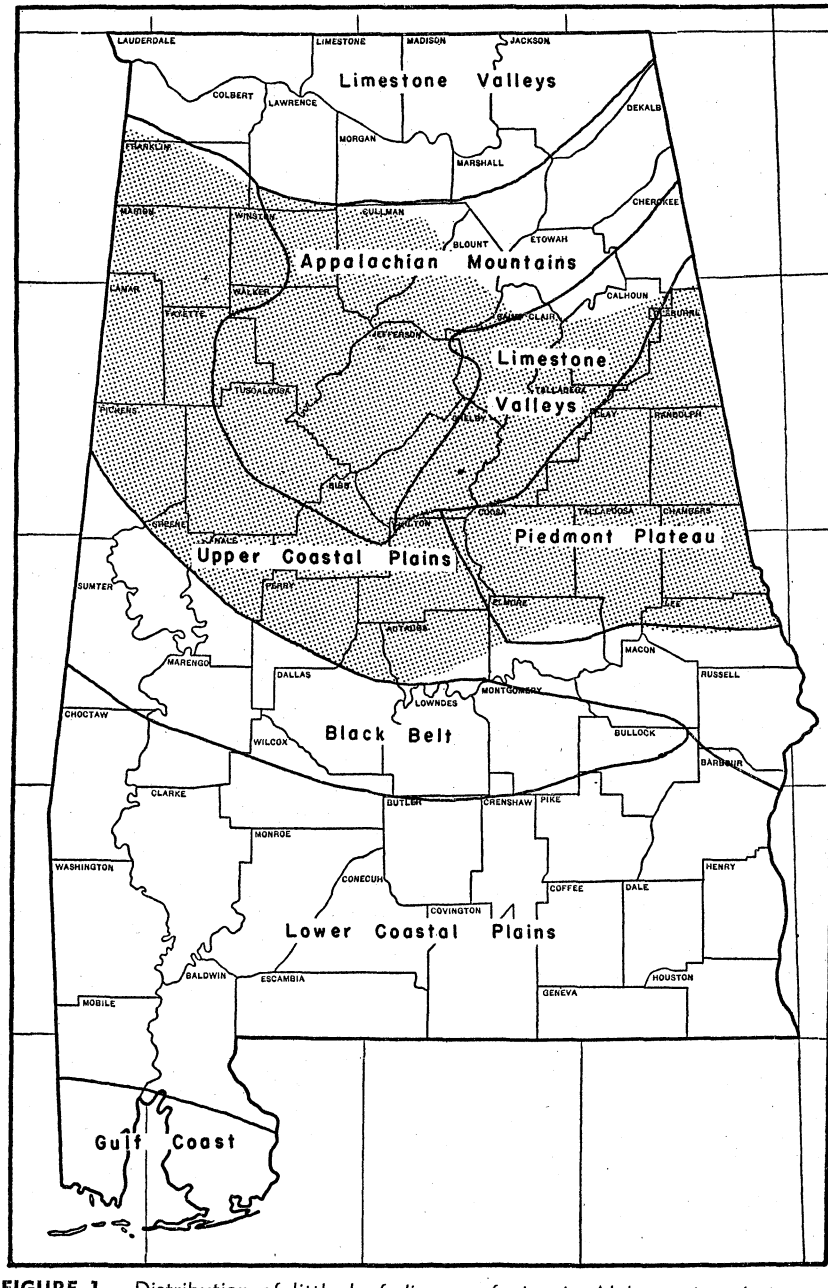

FIGURE 1.—Distribution of little leaf disease of pine in Alabama in relation to the major soil regions. (USDA Cir. 716.)

An extensive research program was started in 1939 by the Division of Forest Pathology, U.S. Department of Agriculture, following a special Congressional appropriation. No specific cause of the disease has been discovered. Many possibilities have been eliminated and several promising leads are being developed.[3]

In 1941 the Alabama Agricultural Experiment Station sponsored a survey of little leaf in two selected areas in the State. This survey gave valuable information on the volume of pine affected and on the conditions under which little leaf occurred.[4]

Characteristics of Little Leaf

Little leaf is most severe on shortleaf pine. Loblolly pine is affected to a lesser extent, and it is occasionally found on Virginia pine. A similar condition reported on longleaf pine has not proved to be little leaf.

The disease is easily recognized, except in the very early stages. Diseased trees have a decided unhealthy appearance; foliage is sparse and usually yellowish green in color.

Shorter needles are produced by diseased trees. As the disease advances twigs and small branches die throughout the crown. Cones are smaller and are retained longer than on healthy trees.

Diameter and height growth is reduced by the disease; in some cases the annual rings are so narrow that they are difficult to count with the naked eye.

Little leaf occurs on a wide variety of soils. The 1941 survey reported little leaf on 30 different soil series in the Piedmont and Upper Coastal Plain regions. Although worse on poorer sites, it is still prevalent in serious proportions on better sites.[5]

Little leaf does not usually occur until trees are about 20 years old. It is more prevalent in the dominant and codominant trees than in the smaller trees of a stand.[6]

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[3] Hepting, George H., Buchanan, Thomas S., and Jackson, L. W. R., 1945. Little Leaf Disease of Pine, U.S.D.A. Cir. 716, 15 pp.

[4] Boggess, W. R., Swarthout, P. A., and Toole, E. R., 1941. Results of the Little Leaf Survey of Southern Pines in Alabama. Ala. Agr. Expt. Sta. Mimeograph. 15 pp.

[5] According to the 1941 survey 75 per cent of the plots with a site index below 50 had little leaf diseased trees present. Plots with a site index above 50 were only 23 per cent diseased on the Upper Coastal Plain Unit.

[6] **Dominant** trees are those with crowns extending above the general level of the canopy and receiving full light from above and partly from the side.
Codominant trees are those with crowns forming the general level of the forest canopy and receiving full light from above but little from the side.

Effect on Forest Stands

Previous reference has been made to the 1941 little leaf survey in Alabama. This survey was made on one unit in the Upper Coastal Plain and another in the Piedmont.

A re-survey of the Piedmont area was completed in August, 1946. This 153,600-acre area lies in a strip 8 miles wide, along U.S. Highway 241, between Waverly and Sylacauga. In the 1941 survey, lines were run across the strip at 2-mile intervals. One-quarter acre circular plots were located, 16 chains apart, along each line. Lines and plots were first located on aerial photographs; this made it possible to re-locate plots for the 1946 re-survey.

The volumes of cordwood and sawtimber[7] on the average acre of the Piedmont Unit in 1941 and 1946 are shown in Tables 1 and 2. Pine volume is shown as healthy, early little leaf, and advanced little leaf.[8] Hardwood volume is divided into soft-textured and firm-textured hardwoods.[9]

In 1941 the sawtimber on the average surveyed acre was 1,262 board feet of pine and 197 board feet of hardwood. Twenty-eight per cent of the pine volume was affected by little leaf.

In 1946 the sawtimber volume on the average acre was 666 board feet of pine and 170 board feet of hardwood. Twenty-nine per cent of the pine volume had little leaf. The total amount of pine sawtimber had been reduced about 47 per cent since 1941. The percentage of little leaf was about the same for 1941 and 1946.

The shortleaf pine sawtimber volume had been reduced from 422 board feet in 1941 to 253 board feet in 1946. Fifty per cent of the shortleaf pine had little leaf in 1941; 44 per cent of the pine volume was affected in 1946.

Loblolly pine sawtimber volume had been reduced from 550 board feet in 1941 to 298 board feet in 1946. The volume af-

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[7] **Cordwood** volume includes all sound trees 5.0-8.9 inches in diameter at 4.5 feet above the ground for pine and 5.0-12.9 inches for hardwood; it also includes cordwood material in the tops of sawtimber trees.
Sawtimber volume includes all sound trees above 9.0 inches in diameter at 4.5 feet above the ground for pine and above 13.0 inches for hardwood.

[8] The stages for little leaf were distinguished as follows: **Early little leaf:** definite symptoms of little leaf but less than ⅓ of the small branches and twigs dead.
Advanced little leaf: foliage scanty and largely confined to the current season's growth. More than ⅓ of the small twigs and branches dead.

[9] Firm-textured hardwoods: oak, ash, elm, hickory, etc. Soft-textured hardwoods: gum, maple, poplar, etc.

TABLE 1.—CORDWOOD AND SAWTIMBER VOLUME ON AVERAGE ACRE OF PINE AND PINE-HARDWOOD TYPES ON SURVEY AREA, PIEDMONT REGION, ALABAMA, 1941

Tree species, groups	Health condition				Percentage of volume with little leaf		
	Healthy	Little leaf		Total	Early	Advanced	Total
		Early	Advanced				
	Cordwood volume (cords)						
PINES							
Shortleaf	.72	.29	.24	1.25	23	19	42
Loblolly	.78	.10	.03	.91	11	3	14
Longleaf	.39	--	--	.39	--	--	--
Total pine	1.89	.39	.27	2.55	15	10	25
HARDWOODS							
Firm-textured	.54	--	--	.54	--	--	--
Soft-textured	.38	--	--	.38	--	--	--
Total hardwood	.92	--	--	.92	--	--	--
	Sawtimber volume (bd. ft.)[1]						
PINES							
Shortleaf	205	132	85	422	30	20	50
Loblolly	420	92	38	550	17	7	24
Longleaf	290	--	--	290	--	--	--
Total pine	915	224	123	1262	18	10	28
HARDWOODS							
Firm-textured	120	--	--	120	--	--	--
Soft-textured	77	--	--	77	--	--	--
Total hardwood	197	--	--	197	--	--	--

[1] Sawtimber volume by International ¼-inch rule.

fected with little leaf was 24 per cent in 1941 and 26 per cent in 1946.

Cordwood volume had not been reduced as greatly as sawtimber. In 1941 the average acre had 2.5 cords of pine and 0.92 cords of hardwood. Five years later there were 2.3 cords of pine and 1.0 cords of hardwood per average acre. The amount of little leaf had increased 6 per cent since 1941. The increase was about the same for shortleaf pine and loblolly pine.

It is difficult to establish reliable pine mortality figures for the last 5 years because of excessive cutting during that period. In 1941 there was 422 board feet of shortleaf pine sawtimber on the average acre. An additional 125 board feet was represented by dead standing or dead down timber. This amount was 30 per cent of the living pine volume. In 1946 the volume of shortleaf pine sawtimber on the average acre was 253 board feet. Dead down and dead standing timber amounted to an additional 50 board feet, or 20 per cent of the living volume of shortleaf

TABLE 2.—CORDWOOD AND SAWTIMBER VOLUME ON AVERAGE ACRE OF PINE AND PINE-HARDWOOD TYPES ON SURVEY AREA, PIEDMONT REGION, ALABAMA, 1946

Tree species, groups	Health condition				Percentage of volume with little leaf		
	Healthy	Little leaf		Total	Little leaf		
		Early	Advanced		Early	Advanced	Total
	Cordwood volume (cords)						
PINES							
Shortleaf	.50	.24	.26	1.0	24	26	50
Loblolly	.64	.18	.05	.87	21	--	21
Longleaf	.44	--	--	.44	--	--	--
Total pine	1.58	.42	.31	2.31	18	13	31
HARDWOODS							
Firm-textured	.60	--	--	.60	--	--	--
Soft-textured	.40	--	--	.40	--	--	--
Total hardwood	1.00	--	--	1.00	--	--	--
	Sawtimber volume (bd. ft.)[1]						
PINES							
Shortleaf	142	61	50	253	24	20	44
Loblolly	220	50	28	298	17	9	26
Longleaf	115	--	--	115	--	--	--
Total pine	477	111	78	666	17	12	29
HARDWOODS							
Firm-textured	90	--	--	90	--	--	--
Soft-textured	80	--	--	80	--	--	--
Total hardwood	170	--	--	170	--	--	--

[1] Sawtimber volume by International ¼-inch rule.

pine. The latter does not represent a true mortality figure for the last 5 years. In 1941 there was 85 board feet of shortleaf pine in an advanced stage of little leaf. If left uncut most of these trees would have died within 5 years. An additional 132 board feet per acre was in an early stage of little leaf. Some of these trees would also have died within the period. In spite of a lack of reliable mortality figures, little leaf has certainly not decreased in the 5 years. Observations over the entire State do not indicate any noticeable improvement in any of the affected areas. Some areas seem to be worse than they were in 1941.

Studies carried on by the Alabama Agricultural Experiment Station give some idea of the losses that result from little leaf. In 1941 a stand improvement study was started in a 17-year-old shortleaf pine-loblolly pine stand on the Station's Experiment Forest Unit in Coosa County. The stand was of old field origin and was about 60 per cent stocked with pine. All trees showing any symptoms of little leaf were removed when the study was

established. In the last 5 years, a 20 per cent loss in growth has resulted from trees becoming affected by little leaf disease. In addition there are now 15 trees per acre, averaging 8 to 10 inches in diameter, which have little leaf and need to be removed. The healthy trees are growing rapidly and do not require another release. However, it is necessary to cut every 3 to 5 years to salvage diseased trees.

In another stand on this Unit, a check has been made to determine the rate of spread of little leaf in a natural stand of loblolly pine-shortleaf pine. This stand is in the 20 to 30 year age class, and is on one of the better sites on the forest. In 1941 all trees showing symptoms of little leaf were removed. Two hundred and ninety-five healthy trees were left on a 2½-acre plot. In 5 years, 13 trees had died, 11 were in an advanced stage of little leaf, and 13 trees showed early symptoms of the disease. Thus, 12 per cent of the pine stems had contracted little leaf or had died as a result of little leaf in 5 years. This rate of mortality, while exceeded on poorer sites of the same forest, illustrates the fact that shortleaf pine growing on good sites is subject to attack by little leaf.

On the Station's Experiment Forest Unit in Fayette County, a salvage cutting to remove little leaf diseased trees was made on 47 acres of shortleaf pine-hardwood type. This forest is located in the Upper Coastal Plain Region; little leaf has not been considered as severe in that region as in the Piedmont. The volume before cutting was 63,264 board feet (Doyle scale) for all species; shortleaf pine volume was 17,128 board feet. The salvage cut removed 38 per cent of the pine volume. A high percentage of the pine volume has been lost prematurely from an already understocked stand.

Effect on Forest Management

In good forest management, trees are removed from timber stands as they mature, when they become diseased, or to give better trees more growing space. Little leaf causes premature death of affected trees. It also causes a decrease in growth. In areas where little leaf is present, forest management practices must be carried on so that trees affected by the disease can be salvaged before they die.

The bulk of the pine sawtimber volume in the Piedmont Region

of Alabama is from 9 to 14 inches in diameter at breast height (4.5 feet above the ground). In the Piedmont and Upper Coastal Plain regions from 50 to 70 per cent of the sawtimber volume is in pine. Results of the 1941 and 1946 little leaf surveys show that approximately 36 per cent of the pine sawtimber volume is shortleaf pine, the species most susceptible to little leaf. In the cordwood volume class, shortleaf pine makes up a higher percentage of the total pine volume. The proportion of shortleaf pine is, therefore, increasing. With the percentage of diseased shortleaf pine running as high as 50 per cent for both cordwood and sawtimber sizes, the outlook for increasing or even maintaining the present pine stand is discouraging. If the present trend of little leaf continues, there will be few, if any, shortleaf pine above 10 inches in diameter within a short time. Also half of the 6- and 8-inch trees that do reach sawtimber size, will probably have little leaf. It does not take many years for such a trend to wipe out the upper diameter classes.

If the high rate of pine mortality continues, forest managers will be forced to consider the possibilities of hardwood management. Pine is considered our best timber crop, but pine is gradually being replaced by hardwood. Unfortunately, many of the hardwoods coming into pine stands have little value on the present market. If pine continues to die, the chances are that it will be replaced by hardwoods.

From this study, it is believed that stands affected by little leaf should be cut every 3 to 5 years to salvage diseased trees. On the average trees die within 5 to 7 years after showing symptoms of little leaf. Results of work by the Alabama Agricultural Experiment Station show that removal of diseased trees will not check the spread of little leaf; it is purely a salvage operation.

Shortleaf pine stands in little leaf areas may have to be managed on a short rotation. Under such a plan shortleaf pine would be removed as it reaches the size and age where it is more susceptible to little leaf. Trees removed could be marketed as pulpwood or for sawing into dimension stock by the recently developed Carpenter Dimension mill.[10]

In most of the natural stands of the Piedmont and Upper Coastal Plain regions, there is a fair mixture of loblolly pine with

[10] This modified edger mill was developed by R. A. Carpenter of Berry, Alabama, and is designed to cut dimension stock from logs down to 5 inches in diameter at the small end. It is described by H. H. Sloss in the August 1946 issue of Alabama Conservation.

the shortleaf pine. It would be wise to encourage the reproduction of loblolly pine, as it is less susceptible to little leaf. Slash pine can be successfully planted in all but the northern-most part of the State. It has been grown to pulpwood size in many locations north of its natural range. Little leaf has never been reported on slash pine. However, only one slash pine plantation has been in existence for 20 years in the areas where pine is affected by little leaf.[11]

Summary

The little leaf disease of pine is common in the Piedmont and Upper Coastal Plain regions of Alabama. In some areas it is a serious threat to the present and future pine stands.

Shortleaf pine is most commonly affected by the little leaf disease. It is also found on loblolly pine and occasionally on Virginia pine.

Little leaf usually attacks trees after they reach 20 years of age. On the average, trees die in 5 to 7 years after showing visible symptoms of the disease.

In certain parts of the Piedmont, as much as 50 per cent of the shortleaf pine has little leaf. Excessive cutting and death, due to little leaf, has reduced the total pine stand as much as 50 per cent in the last 5 years.

It is best to make frequent cuttings in pine stands affected by little leaf. Reproduction of pine species resistant to little leaf should be encouraged.

[11] Planted in 1927 at Auburn by the Alabama Agricultural Experiment Station.