SOUTHERN FOREST EXPERIMENT STATION

1972

U.S. FOREST SERVICE RESEARCH NOTE

SO-142

Forest Service, U.S. Dept. of Agriculture

T-10210 FEDERAL BLDG. 701 LOYOLA AVENUE NEW ORLEANS, LA. 70113

BROWN-SPOT RESISTANCE IN NATURAL STANDS OF LONGLEAF PINE SEEDLINGS

William D. Boyer [1]

SOUTHERN FOREST EXPERIMENT STATION

An average of 10 percent of longleaf pine (Pinus palustris *Mill.) seedlings in several natural populations remained nearly free of brown-spot needle blight* (Scirrhia acicola *(Dearn.) Siggers) year after year, despite high infection levels in the population as a whole. In one study, these individuals averaged 8 feet taller at age 24 than surviving trees that were less resistant to the disease.*

Brown-spot needle blight *(Scirrhia acicola* (Dearn.) Siggers), the most serious disease of longleaf pine *(Pinus palustris* Mill.) seedlings, delays height growth by defoliating and may eventually kill many seedlings *(4, 5)*. Some individuals seem to be genetically resistant to brown spot *(2, 5)*, and this characteristic is being exploited in the development of disease-resistant strains *(3)*. No quantitative information has been published, however, on the occurrence of brown-spot-resistant seedlings in natural populations. Four studies of natural regeneration problems provide some of the necessary information, which is reported in this paper.

[1] Principal Silviculturist at the Silviculture Laboratory, South. Forest Exp. Stn., USDA Forest Serv., Brewton, Ala.

METHODS

Detailed information was gathered in four separate studies on the development of 1,783 individual longleaf pine seedlings for periods of at least 4 successive years. Three studies were done on the Coastal Plains of south Alabama on the Escambia Experimental Forest or Conecuh National Forest, and one in the Mountain Province of northern Alabama. Information on the location, year of seeding, and seedling examinations in each study are given in table 1.

Individual seedlings selected for observation were identified by a wire pin on the ground, and their locations were marked on plot maps. In brown-spot examinations, each marked longleaf pine seedling was inspected in the winter, and the proportion of current-year foliage destroyed by brown spot was estimated to the nearest 10 percent.

Table 1.—*Study locations and seedling observations*

Study	Location	Year of seeding	Number of winter examinations	Ages of examined seedlings
1	Escambia Experimental Forest Conecuh National Forest	1947	7	1-10
2 a	Escambia Experimental Forest	1957, 1958	7	1, 2-7, 8
b	Escambia Experimental Forest	1957, 1958	6	2, 3-7, 8
3	Escambia Experimental Forest	1955	4	2-5
4	Coosa County, Alabama	1961	6	1-6

Four brown-spot infection classes were set up on the basis of percent of infection: (1) light (0-10 percent), (2) moderate (20 percent), (3) heavy (30-40 percent), and (4) severe (50 percent or more). Each seedling was assigned to the class in which it fell in the year when it was most severely infected. Class rating achieved over a number of years should be a good indication of the relative susceptibility of seedlings, but that for 1 or 2 years apparently is not. For example, even in the worst single infection year the number of class 1 seedlings was more than double the number that remained in class 1 for 4 or more years.

Individual longleaf pine trees in study 1 were relocated during the late summer of 1971 to check for relationships between seedling brown-spot status and subsequent survival and growth. Heights and diameters of survivors were measured at that time, when trees were 24 years old.

RESULTS

Small but significant fractions of the natural longleaf pine seedling populations appeared to be resistant to brown spot. The proportion that had no more than 10 percent infection (class 1) for the entire period of observation was about 12 percent in south Alabama and 5 percent in the north (table 2). If seedlings no more than moderately infected (class 2) are included, the relatively resistant fraction ranged from 12 to 28 percent of the stands. In terms of trees per acre at the final examination seedlings in class 1 and 2 combined amounted to about 500 per acre in studies 1 and 3, 900 in study 2, and 2,000 in study 4. The large number in study 4 was due to a high initial stocking of seedlings.

Table 2.—*Distribution of marked longleaf pine seedlings among brown-spot infection classes based on highest infection recorded over all years of observation*

Brown-spot infection class	Study			
	1	2	3	4
	Percent			
1	12.8	12.2	12.1	4.7
2	8.3	9.8	16.2	6.9
3	19.9	33.3	33.1	24.0
4	59.0	44.7	38.6	64.4

The proportion of seedlings lightly infected by brown spot will be influenced by intensity of the disease in the area. When average infection levels are light, of course, a large percentage of the seedlings will be in class 1. When brown-spot infection levels are high for several years, most of the susceptible seedlings will become diseased. The severity of infection on an individual seedling in any given year probably reflects complex interactions between the current degree of seedling susceptibility and microenvironmental fluxes affecting the disease itself.

Average infection levels reached during the worst year in each study were 31, 32, 42, and 46 percent for studies 3, 2, 1, and 4, respectively. Among studies, an increasing severity of the disease produced a net shift of seedlings into the highest brown-spot infection class. Except in study 4, the proportion of class 1 seedlings was unaffected.

Seedlings that remained free of brown spot (class 1) were nearly always larger, as a group, than those that had moderate to severe infection at some time. For example, in study 1, average root-collar diameters of 10-year-old

seedlings in infection classes 1 through 4 were 1.49, 1.35, 1.10, and 0.95 inches, respectively. Sixty-three percent of class 1 seedlings were in active height growth (0.5 foot or more to base of bud), compared to 40 percent for class 4.

The initial size advantage of the brown-spot-resistant longleaf pines in study 1 has widened through age 24 (table 3). Class 1 trees averaged 8 feet taller than those in both classes 3 and 4. Class 2 trees were nearly as large as class 1; the height gap that separated them narrowed between ages 10 and 24. Except for survival, there was no difference in performance between classes 3 and 4.

Table 3.—*Fate of trees through age 24, by brown-spot infection class through age 10*

Brown-spot infection class	Survival age 10-24	Average size of survivors		
		Age 10	Age 24	
		Height	Height	D.b.h.
	Percent	*Feet*	*Feet*	*Inches*
1	64	4.5	37	4.0
2	64	2.6	35	3.7
3	40	2.5	29	3.1
4	20	2.1	29	3.2

Differential mortality increased the proportion of brown-spot-resistant trees in the stand, and 39 percent of all survivors to age 24 were in class 1 or 2. These two classes comprised 56 percent of the dominant trees exceeding 40 feet in height. All five of the trees over 50 feet in height were class 1 seedlings.

DISCUSSION

Apparently, a small but important fraction of longleaf pine seedlings in natural stands is able to remain substantially free of brown-spot infection year after year, even though most of their neighbors are heavily infected. Most of these seedlings have superior juvenile growth, which may reflect the lack of significant suppression by brown spot, or may be associated with some common factors behind both growth and freedom from infection.

Brown-spot-free seedlings, as a group, survived better and grew more rapidly than other seedlings through age 24. Similar observations were reported by Wakeley *(6)* for longleaf pine plantations at 30 years of age. As the stand develops, the disease-free individuals account for an increasing proportion of the dominant stand.

The development of resistant strains of longleaf pine with desirable growth properties is a long-term undertaking. In the meantime, the manager can capitalize upon the reservoir of disease resistance that may exist in his longleaf pine forests. This potential should be recognized and fully exploited through cultural and cutting practices designed to favor these superior trees, beginning with the earliest years of the stand. In the past, prescribed burning for control of brown spot in grass-stage seedling stands has often discriminated against the disease-free seedlings because it kills the ones that are in the early stages of height growth. Croker *(1)* pointed out the importance of basing fire prescriptions on the condition of these superior "crop seedlings" rather than the seedling population as a whole.

Natural regeneration following a good longleaf pine seed crop often provides established seedlings in such numbers that the superior fraction alone can provide a full stand. The manager has an opportunity to improve the quality of his longleaf stands by reserving trees that are not only disease resistant, with desirable growth characteristics, but also demonstrably and perhaps uniquely adapted to local site conditions.

LITERATURE CITED

1. Croker, T. C., Jr.
   1967. Crop-seedling method for planning brown-spot burns in longleaf pine. J. For. 65: 488.

2. Derr, H. J.
   1963. Brown-spot resistance among F_1 progeny of a single, resistant longleaf parent. *In* Forest Genet. Workshop Proc. 1962: 16-17. South. Forest Tree Improv. Comm. and Soc. Am. For. Tree Improv. Comm.

3. Derr, H. J., and Melder, T. W.
   1970. Brown-spot resistance in longleaf pine. Forest Sci. 16: 204-209.

4. Lightle, P. C.
1969. Brown-spot needle blight of longleaf pine. USDA Forest Serv. Forest Pest Leafl. 44 (rev.), 7 p.

5. Siggers, P. V.
1944. The brown spot needle blight of pine seedlings. U. S. Dep. Agric. Tech. Bull. 870, 36 p.

6. Wakeley, P. C.
1970. Thirty-year effects of uncontrolled brown spot on planted longleaf pine. Forest Sci. 16: 197-202.