

THE GROWTH OF PONDEROSA PINE IN ILLINOIS LIMITED BY THE NEEDLE BLIGHT

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ABSTRACT.—For the purpose of testing the adaptability of ponderosa pine for forest planting in Illinois, 9 seed origins (1 each from Nebraska, North Dakota, and Montana and 2 each from Colorado, Idaho, and Oregon) provided planting stock for 21 plantations in 6 counties in 1941 and 1942. At age 20, the needle blight (*Scirrhia pini*, Funk and Parker) caused more than 90 percent mortality in 12 of the 21 plantations, and 5 years later, 8 of the remaining 9 plantations had reached or were entering this stage of infection. The early growth of ponderosa pine was exceeded by red, white, and jack pines in northern and central Illinois, and by loblolly, shortleaf, and Virginia pines in southern Illinois.

One of the goals of a newly created Department of Forestry, University of Illinois, in 1938 was to determine the growth potential and usefulness of a number of forest tree species for planting in Illinois. Because of its extensive geographic range which takes it through a wide variety of topographic and climatic features, ponderosa pine (*Pinus ponderosa* Laws.) was one of the species chosen for this study. It is the most widely distributed pine in western North America, extending from southern British Columbia in the north to mid-Mexico in the south. In the United States it occurs in commercial quantities in every state west of the Great Plains and is generally found in a subhumid humidity province characterized by a summer rainfall deficiency. The early results of this study, involving 9 seed

sources of ponderosa pine, were summarized by Lorenz (1949). A number of studies pertaining to racial or ecotypic variation in ponderosa pine showed differences in survival, growth, and morphological characteristics of foliage (Weidman, 1939; Munger, 1947; Mirov *et al.*, 1952; and Squillace and Silen, 1962). From the data provided by two ponderosa pine provenance studies conducted in northern Idaho (45 years old) and in Oregon and Washington (30 years old), Squillace and Silen (1962) found that trees which grew most rapidly came from seed origins located where precipitation and temperature patterns matched the climatic pattern of their planting sites. Altitudinal races were reported by Mirov *et al.* (1952). More recently the North Central Forest Tree Breeding Committee, NC-51, in cooperation with the United States Forest Service, established an 80-origin seed source study of ponderosa pine in 8 states and 2 Canadian provinces (unpublished committee report 1968).

Illinois extends 385 miles from north to south, approximately one-third the distance between the Canadian border and the Gulf of Mexico. Native conifers are very sparsely represented in Illinois. Eastern red cedar (*Juniperus virginiana* L.) is the only native conifer with statewide distribution. Three northern

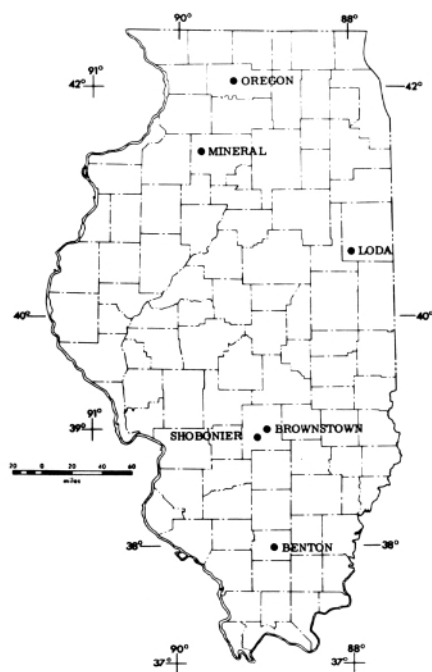


FIGURE 1. Location of ponderosa pine plantations established for species adaptation study.

conifers occur naturally in northern Illinois and two southern conifers are native to its southern tip. Moisture is seldom a limiting factor for tree growth in Illinois. Approximately 60 percent of the annual precipitation occurs during the growing season. The average annual precipitation in Illinois increases from 32 inches in the north to 46 inches in the south.

THE NEEDLE BLIGHT OF PONDEROSA PINE

Robert L. Hulbary (1941) described a previously unnamed needle blight (*Dothistroma pini* Hulbary) found on Austrian pine (*P. nigra* Arnold) in northern Illinois, and

Funk and Parker (1966) described its perfect state and named it *Scirrha pini*. Previous to this time, long standing confusion had existed in the taxonomic literature with regard to the separation of the species in the genus *Scirrha*, especially between *S. pini* and the brown spot needle blight of southern pine (*S. acicola* (Dearn) Siggers). Peterson (1965) reported that the *D. pini* blight was causing serious damage to Austrian and ponderosa pine in windbreak, ornamental, and Christmas tree plantings in the central and southern Great Plains (Nebraska, Kansas, and Oklahoma). Carter (1967, p. 9) made the following statement to the Indiana Arborist Association meeting:

"This leaf disease, caused by the fungus *Dothistroma pini*, is widespread in the United States, Canada, Chile and Kenya."

He briefly described the disease as follows:

"Symptoms of the disease appear in late summer as slightly swollen, dark spots or bands on one-year-old and older needles. On some pines the banded areas become red — a condition referred to as 'red-banding.' The part of a diseased needle from the swollen and discolored area to the tip turns light brown and dies."

In an appraisal of the needle blight in California, Wagener (1967, p. 4) stated that

"The speed with which the red band blight became established in new centers around the world is probably unparalleled in the history of tree diseases."

He also stated that the disease has been reported on about 30 species, varieties, or hybrid pine. Dr. J. C. Carter and Dr. D. F. Schoeneweiss, plant pathologists at the Illinois Natural History Survey, have, on the basis of field and laboratory observations, confirmed that identification

of the needle blight on ponderosa pine plantations throughout Illinois as *Scirrhia pini* Funk and Parker.

SEEDING AND PLANTING

Nine seed sources were used to establish the 21 plantations comprising this study, eight were furnished by the United States Forest Service, and one came from a commercial seedhouse. The locations and altitudes of the seed origins are given in Table 1. Field plantings were

made at 6 locations from northern to southern Illinois as shown on the map (Fig. 1). Each of the 9 sources was represented by a single block planting at 1 to 4 of the locations, but unfortunately replicated plantings were not made at all locations from all seed sources. The size of the average planting was one-third of an acre comprising 413 trees; the smallest planting contained 174 trees, and the largest planting 1,225 trees. Seed from the four sources obtained in 1939 (Colorado; Idaho

TABLE 1.—Location and altitude of ponderosa pine seed origins.

State	City	National Forest	Latitude	Longitude	Altitude, Feet
Nebraska.....	Halsey.....	Nebraska..	41° 52'	100° 20'	2,600
North Dakota.....	Medora.....	46° 50'	103° 36'	2,900
Colorado.....	Pueblo.....	San Isabel.	38° 20'	105° 10'	7,000
Colorado.....
Montana.....	Missoula.....	Lolo.....	46° 48'	114° 5'	3,500
Idaho.....	Idaho City.....	Boise.....	43° 48'	115° 45'	4,300
Idaho.....	McCall.....	Fayette.....	44° 50'	116° 8'	5,000
Oregon.....	Bend.....	Deschutes..	44° 0'	121° 20'	3,950
Oregon.....	LaPine.....	Deschutes..	43° 44'	121° 36'	3,830

City, Idaho; Bend and LaPine, Oregon) were grown in the Union State Tree Nursery in southern Illinois and were planted in the spring of 1941 as 2-0 seedlings in 6 x 6 foot spacings. Similar treatment was given to the 5 seed sources obtained in 1940 (Halsey, Nebraska; Medora, North Dakota; Pueblo, Colorado; Missoula, Montana; and McCall, Idaho) except that they were grown in the Mason State Tree Nursery in central Illinois and planted in the spring of 1942. The plantings were made on old fields which had not been cultivated for a number of years. The fields at Loda and Sho-

bonier were severely eroded. The soil descriptions for the planted areas as described by Wascher *et al.* (1950) are as follows: Oregon, Bloomfield fine sand; Mineral, Plainfield sand; Loda, Chatsworth silt loam; Brownstown, Bluford and Wynoose silt loam; Shobonier, Hickory loam; and Benton, Hickory loam with some Ava and Bluford silt loam. Survival was excellent in the early years, except at Mineral, where volunteer sweet clover, fires, and theft took their toll. At age 10 a release cutting was made in several of the plantings at Benton and in two plantings at Brownstown.

RESULTS

The Needle Blight

The needle blight did not manifest itself to a noticeable degree until after the 5-year measurements were made. Annual measurements were not made between the ages of 5 and 10, but at age 10, 13 of the 21 plantations showed noticeable infection with incidence ratings varying from 1 through 3. Seven numerical classes were employed to describe the incidence of needle blight as follows:

- 0—not apparent
- 1—incipient stages
- 2—light—lower foliage whorl dead
- 3—moderate—25 to 50 percent of foliage dead
- 4—heavy—50 to 75 percent of foliage dead
- 5—severe—75 to 90 percent of foliage dead
- 6—more than 90 percent of the trees dead

The trees in any one plantation responded quite uniformly in the manner and rate at which the infected foliage died progressively upward from the bottom whorl to the tip (Fig. 2). Twelve of the 21 plantations had more than 90 percent mortality at age 20. Growth data were not taken at age 25, but an appraisal of the needle blight incidence showed that 8 of the 9 remaining plantations were entering or had reached the 90 percent mortality stage. The numerical ratings for the incidence of needle blight are given in Table 2. In general, at the same locations and on similar planting sites, the plantations originating from seed west of the Continental Divide showed a higher incidence of needle blight than those whose seed originated east of the Continental Divide.



FIGURE 2. A severe infection of needle blight on ponderosa pine, age 15, at Benton, Illinois. The seed source was from the Deschutes National Forest in Oregon.

Diameter and Height Growth

Diameter and height growth for the 21 plantations are given in Table 2 for ages 5, 10, 15, and 20. Although growth data were confounded by the needle blight, several comparisons should be given. Seeds from the Missoula area at an altitude of 3,500 feet in the Lolo National Forest produced trees with the greatest height at age 15, both in the northernmost and southernmost planting locations. Also at age 15, very little difference in heights was noted between the plantations originating from seed west of the Continental Divide and those originating from seed east of the Continental Divide.

TABLE 2.—Performance of ponderosa pine seed sources at ages 5, 10, 15, and 20 years in Illinois plantations.

Location of Plantation and Seed Origin	Survival				Mean D.B.H.				Mean Height				Incidence of Needle Blight			
	5	10	15	20	5	10	15	20	5	10	15	20	5	10	15	20
	Percent				Inches				Feet							
Oregon, Ogle County	57	56	56	33												
Nebraska, Halsey	87	87	85	77	1.9	3.5	4.8		2.8	9.2	16.4	25.0	0	1	3	5
North Dakota, Medora	98	98	97	77	2.1	3.9	4.9		3.2	10.8	20.1	29.4	0	0	2	4
Colorado, Pueblo	89	87	86	73	1.8	3.6	4.8		2.6	7.3	16.9	22.2	0	1	2	4
Colorado	84	82	79		2.0	3.5	4.8		3.1	9.6	17.6	24.6	0	1	2	3
Montana, Missoula	84	82	79		2.6	4.2			3.5	11.4	20.3		0	2	5	6
Idaho, Idaho City	84	71	69		2.3	3.5			3.0	9.7	16.0		0	1	5	6
Idaho, McCall	80	76	65		2.4	4.0			3.2	10.3	16.7		0	3	5	6
Oregon, Bend	94	91	88		2.7	4.0			3.9	11.5	18.4		0	3	5	6
Mineral, Bureau County																
Colorado	17	12	9	7	1.6	4.8	7.2		2.1	7.5	15.6	23.2	0	0	0	1
Loda, Iroquois County																
Nebraska, Halsey	67	56	55	30	0.4	1.8	3.1		1.4	4.5	9.1	14.6	0	0	0	2
Brownstown, Fayette County																
Nebraska, Halsey	87	87	86	11	1.2	2.7			2.2	7.1	14.3		0	0	3	6
Colorado, Pueblo	88	87	86	65	1.2	2.7	3.7		2.0	6.6	13.5	20.8	0	0	2	5
Shobonier, Fayette County																
Colorado, Pueblo	87	42	42	18	1.2	3.4	4.1		2.0	6.4	14.1	23.5	0	0	2	5
Montana, Missoula	84	67	25		1.7	3.0			2.4	8.5	15.6		0	2	5	6
Benton, Franklin County																
Nebraska, Halsey	97	32	31		1.6	3.1			2.8	8.5	16.1		0	0	3	6
Colorado, Pueblo	89	23	21		1.1	2.5			2.1	6.2	12.1		0	2	3	6
Colorado	93	93	93	64	1.5	3.1	4.2		3.1	7.5	14.5	20.6	0	0	3	5
Montana, Missoula	96	89	28		1.9	3.1			3.3	9.0	16.8		0	2	5	6
Idaho, Idaho City	92	88	51		1.6	3.0			2.7	7.8	13.6		0	3	5	6
Oregon, Bend	92	92	79		1.7	3.3			2.8	8.2	14.8		0	3	5	6
Oregon, La Pine	99	98	80		1.8	3.1			3.0	8.3	13.5		0	1	5	6

DISCUSSION

There was some evidence that a more protected site with its shade and reduced wind velocities may predispose ponderosa pine to the needle blight. Ponderosa pine plantations established at Mineral and Benton with trees from the same seed source (Colorado) showed no-

ticeable differences with respect to needle blight infection with incidence ratings of 1 and 5, respectively, at age 20. The trees at Mineral were open-grown on a dry, sandy knoll with adequate air drainage (Fig. 3); those at Benton were on a more protected site with heavy soil, more shade, and reduced wind velocities. Although not part of



FIGURE 3. This 27-year-old plantation of ponderosa pine is unique because it has not succumbed to the needle blight. It was established from Colorado seed on a well-exposed site of drifting sand (Plainfield) near Mineral.

this original study, the light infection of 2 33-year-old ponderosa pine plantations on dry, prairie, sand knolls in Mason County also supported this contention. These observations support those of Van Haverbeke and Bolt (1968), who stated that released ponderosa pine in eastern Nebraska shelterbelts showed less infection than those that were not released. They suggested that the heavy shade and reduced wind velocities inside the untreated segments created a slightly more moist atmosphere which favored the germination of the spores and subsequent growth of the fungus. Rogerson (1954) noted that during the rain-deficient year of 1952 in Kansas, there was no new development of *Dothistroma* needle blight, whereas during the wet year of 1951, incidence of the disease increased markedly. Lack of replication did not permit statistical analysis of the data; nevertheless, the significant role of the needle blight was demonstrated by the fact that at age 25, 20 of the 21 plantations had more than 90 percent mortality or were entering this stage of infection.

The early growth of ponderosa pine on light soils in northern Illinois compared favorably with that of red pine (*Pinus resinosa* Ait.) but was greatly exceeded by that of jack pine (*Pinus banksiana* Lamb.). At age 5, 8 separate seed sources of ponderosa pine on Bloomfield fine sand near Oregon, in north-central Illinois, had a combined mean height average of 3.2 feet, while adjacent red and jack pine plots of the same age had average mean heights of 3.3 and 7.2 feet,

respectively. Likewise, the early growth of red, white (*Pinus strobus* L.), and jack pine exceeded that of ponderosa pine on most sites in central Illinois, and in southern Illinois loblolly pine (*Pinus taeda* L.), shortleaf pine (*Pinus echinata* Mill.), and Virginia pine (*Pinus virginiana* Mill.) far surpassed that of ponderosa pine, Lorenz (1949).

SUMMARY AND CONCLUSIONS

For the purpose of testing the adaptability of ponderosa pine for forest planting in Illinois, 9 seed origins (1 each from Nebraska, North Dakota, and Montana and 2 each from Colorado, Idaho, and Oregon) provided planting stock for 21 plantations in 6 counties in 1941 and 1942. Each of the 9 sources was represented by a single block planting at 1 to 4 of the 6 locations. The needle blight determined the fate of all but one of the 21 plantations. Twelve of the original 21 plantations had more than 90 percent mortality at age 20, and 5 years later 8 of the remaining 9 had reached or were entering this degree of infection. There was some evidence that the more open and exposed plantings on sandy soils showed a lower incidence of needle blight due to a drier habitat. The early growth of ponderosa pine was generally exceeded by red, white, and jack pine in northern and central Illinois and by loblolly, shortleaf, and Virginia pine in southern Illinois. In order to minimize damage from the needle blight disease, the forest planting of ponderosa pine in Illinois should be confined to the dry, sandy knolls with adequate air

drainage such as those found in Bureau, Cass, Henderson, and Mason counties.

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