Resistance to Dothistroma pini within Geographic Sources of Pinus nigra

Glenn W. Peterson and Ralph A. Read

Plant Pathologist and Silviculturist, respectively, Rocky Mountain Forest and Range Experiment Station, Forest Service, USDA, Lincoln, Nebraska 68503, in cooperation with the University of Nebraska Agricultural Experiment Station.

Accepted for publication 3 September 1970.

ABSTRACT

Trees of *Pinus nigra* from 21 geographic sources were evaluated for resistance to the needle blight fungus, *Dothistroma pini*, 5 and 6 years after they were planted in eastern Nebraska. Some individual trees within 16 sources were highly resistant; those from only one geographic source (Yugoslavia) showed universally high resistance. Phytopathology 61:149-150.

The needle blight fungus, *Dothistroma pini* Hulbary, has extensively damaged *Pinus nigra* Arnold in landscape, shelterbelt, and Christmas tree plantings in the United States (3, 5). Although European black pine (*P. nigra*) is a highly variable species, the Austrian pine, *P. nigra* var. *austriaca* (Hoess) Aschers & Graebn., has been more widely used in the United States than other varieties (1).

Through a regional program (NC-51) supported by the Cooperative State Research Service of the USDA, seedlings of 29 different origins of *P. nigra* were produced from seed in a Michigan nursery in 1959. Differences in nursery performance were reported by Wright & Bull (6). Seedlings were then distributed to cooperators by J. W. Wright, Michigan State University, and were outplanted at 14 locations in the North Central states, where performance is being evaluated.

Natural infection by *Dothistroma pini* in one of these provenance plantings in eastern Nebraska afforded an opportunity to evaluate 21 of the origins for resistance to the fungus. Since the fungus has not been observed on older *P. nigra* trees in the vicinity of this plantation, it was probably introduced on planting stock of this or other nearby plantations.

MATERIALS AND METHODS.—*Experimental planting.*—Seedlings from 26 of the geographic sources (6) were planted in 1962 on a previously cultivated, terraced, east-facing upper slope of deep silt loam derived from loess and glacial till. Two-year-old seedlings grown in Michigan had been transplanted to a Nebraska nursery for 1 year before outplanting. Trees were planted in a five-replicate randomized block design with four-tree linear plots. Trees were spaced 7 ft apart within rows and 12 ft apart between rows. Weeds were controlled by herbicides and mowing. Annual measurements provided data for height-growth curves. Twenty-one of the origins (Table 1) were used for the present evaluation, since seedlings from 5 sources died during the first winter.

Disease evaluations.—Shoots were removed from trees when symptoms of Dothistroma needle blight were well developed (early winter). Infection was evaluated

TABLE 1. Infection of *Pinus nigra* from 21 geographic sources by *Dothistroma pini* in eastern Nebraska in 1968

Source	1967 Needles		1968 Needles	
	% Infected needles[a]	Lesion rating[b]	% Infected needles[a]	Lesion rating[b]
415 Yugoslavia	6 a[c]	0.7 a[c]	0 a[c]	0.0 a[c]
423 Austria	23 ab	1.0 ab	4 abc	0.4 ab
418 Greece	44 bc	1.4 abc	1 ab	0.3 ab
424 Greece	51 bcd	1.5 abcd	11 abcd	0.7 abc
420 Greece	53 bcde	1.6 abcd	9 abcd	0.7 abc
417 Greece	55 bcde	1.7 bcd	5 abc	0.6 ab
401 Turkey	71 cdef	1.9 cde	26 bcd	0.8 abc
409 Turkey	75 cdefg	1.8 bcde	13 abcd	0.7 abc
405 Turkey	79 cdefg	1.9 cde	19 abcd	0.9 abc
419 Greece	79 cdefg	1.8 bcd	16 abcd	0.8 abc
408 Crimea	80 cdefg	1.8 bcde	22 abcd	0.8 abc
406 Turkey	84 cdefg	1.9 cde	35 cde	1.1 bcd
404 Turkey	87 cdefg	2.2 cdef	28 bcde	1.1 bcd
428 Greece	88 cdefg	2.2 cdef	22 abcd	1.0 bcd
407 France	89 cdefg	2.0 cde	6 abc	0.4 ab
412 Corsica	90 cdefg	2.4 def	75 ef	1.8 de
426 Greece	93 defg	2.4 def	36 cde	1.1 bcd
427 Greece	94 efg	2.4 def	28 bcde	1.1 bcd
402 Spain	98 fg	2.7 ef	53 de	1.5 cde
403 Spain	100 fg	2.9 f	75 ef	1.9 de
421 Greece	100 g	3.0 f	96 f	2.1 e
Avg	73	2.0	28	0.9

[a] Basis: 50 needles on one shoot from each of 20 trees (four trees × five replications).
[b] Basis: shoots rated by the average number of lesions on needles: 0 = no lesions; 1 = 1-3; 2 = 4-20; 3 = more than 20.
[c] Quantities with letters in common are not significantly different at the 5% level.

by (i) determining the percentage of infected needles in samples obtained from shoots; and (ii) rating shoots on the basis of numbers of lesions on infected needles.

Statistical analysis.—An analysis of variance using plot means was calculated for per cent of infected needles and lesion ratings. For each analysis, the degrees of freedom were: source 20, replicates 4, error 80, total 104. Duncan's multiple range test (5% level) was used to separate means.

RESULTS.—Dothistroma needle blight was epidemic in the 2 years (1967, 1968) the experimental plantings were evaluated. Since results were similar in both years, only the 1968 data are presented.

Seedlings from only one source, No. 415 from Tara plateau in central Yugoslavia, were highly resistant (Table 1); those from source No. 423, from eastern Austria, were moderately resistant. Some individuals within 16 of the 21 sources had a high degree of resistance (Table 2).

Highly resistant trees from source 415 also were superior to all other sources in height growth. Moderately resistant trees from source 423 were third best in height growth, but those from source 417 (highly susceptible) were second best in height growth.

Second-year needles showed a higher level of infection than first-year (current year) needles within all sources (Table 1). Some trees whose second-year needles were susceptible had first-year needles that were resistant.

DISCUSSION.—For the first time, resistance to *D. pini* has been found in *P. nigra* from several localities within the natural range of the species. Previously, Peterson (4) had observed resistance in some Austrian pines (*P. nigra* var. *austriaca*) in plantings in the Great Plains. The results thus indicate that a broad range of genetic material can be utilized in selecting and breeding *P. nigra* for resistance to *D. pini*. Furthermore, a high degree of resistance can be expected in the progeny of certain seed origins, such as source No. 415, from central Yugoslavia.

Dothistroma pini has been reported on *P. nigra* in Yugoslavia and in a few other European countries (2). Information on the European distribution of *D. pini* is too limited, however, to properly assess the relationship of this fungus to natural selection for resistance within *P. nigra* in Europe.

TABLE 2. Percentage[a] of trees from each of 21 geographic sources of *Pinus nigra* with first- and second-year needles free of infection (*Dothistroma pini*) and first-year needles free of infection

Source	Percentage of trees free of infection on	
	First- and second-year needles	First-year needles
415 Yugoslavia	35	100
423 Austria	35	65
420 Greece	25	50
424 Greece	21	57
419 Greece	17	50
418 Greece	16	74
404 Turkey	12	38
401 Turkey	11	48
412 Corsica	8	17
405 Turkey	6	38
408 Crimea	6	47
406 Turkey	6	24
407 France	5	65
417 Greece	5	55
409 Turkey	5	50
426 Greece	5	32
427 Greece	0	38
428 Greece	0	30
402 Spain	0	21
403 Spain	0	5
421 Greece	0	0
Avg	10	43

[a] Determined from 20 trees (five replicates × four trees).

LITERATURE CITED

1. LEE, C. H. 1968. Geographic variation in European black pine. Silvae Genet. 17:165-172.
2. MURRAY, J. S. 1967. Dothistroma pini Hulbary—its occurrence in Europe. XIV. Int. Union Forest. Res. Org.-Congress, Sect. 24. p. 265-268.
3. PETERSON, G. W. 1965. Dothistroma needle blight of Austrian pine: infection and control. Plant Dis. Reptr. 49:124-126.
4. PETERSON, G. W. 1967. Dothistroma needle blight of Austrian and ponderosa pines: epidemiology and control. Phytopathology 57:437-441.
5. PETERSON, G. W. 1967. Dothistroma needle blight of pines in North America. XIV. Int. Union Forest. Res. Org.-Congress, Sect. 24, p. 269-278.
6. WRIGHT, J. W., & W. I. BULL. 1962. Geographic variation in European black pine—two-year results. Forest Sci. 8:32-42.