PATHOGENIC VARIABILITY IN *CRONARTIUM FUSIFORME*

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Investigations are in progress at the Southern and Southeastern Forest Experiment Stations to determine if pathogenic variability exists in *Cronartium fusiforme* Hedgc. & Hunt ex Cumm. The likelihood that such variability occurs has been suspected for some time, and was strengthened by the recent discovery of variability in C. *quercuum* (Berk.) Miyabe ex Shirai (Kais and Snow 1969; Powers 1969), a less important pine-oak rust fungus found within the range of C. *fusiforme.* This paper reviews results from recently completed or current studies at the two stations.

At the Southeastern Forest Experiment Station, seedlings of several southern pine species were inoculated with four isolates of *Cronartium* spp. The isolates were obtained from: (1) a cerebroid gall on a loblolly pine in the upper Piedmont of South Carolina, (2) a fusoid gall on a loblolly pine in the same part of South Carolina, (3) a fusoid gall on a Sonderegger pine in south Mississippi, and (4) a cerebroid gall on a loblolly pine near Charleston, South Carolina. Inoculations were made by suspending telia-bearing oak leaves over potted pine seedlings, according to the method devised by Jewell (1960).

There was no significant pathogenic variability among these isolates (table 1). The proportion of plants of each species developing galls was approximately the same for each isolate, and the galls which developed were for the most part spindle-shaped. Although the results are in general agreement with the data for *Cronartium fusiforme* published by Hedgcock and Siggers (1949), some discrepancies exist. Probably the most noteworthy difference is that these authors found pond pine to be as susceptible as slash pine, whereas in the present data it appears highly resistant to all four rust isolates. The highest infection on this species was 7 percent.

Originally it was thought that the two isolates from cerebroid galls were possibly *Cronartium quercuum.* The fact that inoculations with all four isolates resulted in primarily fusoid galls suggests that they were all C. *fusiforme,* and that gall shape cannot be used to distinguish C. *quercuum* from C. *fusiforme* on loblolly pine.

In a current study at Gulfport, five selections of pine seedlings were inoculated with isolates of *Cronartium fusiforme.* Included were susceptible slash pine, resistant slash pine, susceptible loblolly, resistant loblolly, and shortleaf. The slash pines were from seed of one resistant and one susceptible tree in Mississippi; the trees had been wind-pollinated. The loblolly seed was from control-pollinated trees in south Louisiana, and the shortleaf seed was a bulk

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Table 1.--Percentage of pine seedlings which developed fusiform rust galls after inoculation with Cronartium fusiforme from three geographic sources

Pine species	Sources of inoculum[1/]							
	South Carolina (1)		South Carolina (2)		Mississippi		South Carolina (3)	
	Percent	No. seedlings	Percent	No. seedlings	Percent	No. seedlings	Percent	No. seedlings
Loblolly (*P. taeda* L.)	28	222	45	337	27	122	35	255
Slash (*P. elliottii* var. *elliottii*)	53	301	42	289	48	205	58	481
South Florida slash (*P. elliottii* var. *densa* Little & Dorman	82	216	82	113	76	68	85	128
Shortleaf (*P. echinata* Mill.)	1	347	4	279	4	73	0	311
Virginia (*P. virginiana* Mill.)	2	579	1	603	2	129	0	296
Spruce (*P. glabra* Walt.)	...	...	0	169	0	87	0	106
Pond (*P. serotina* Michx.)	0	24	1	404	1	198	7	307
Sand (*P. clausa* (Chapm.) Vasey)	3	209	0	211	0	78	0	241

1/ South Carolina isolates (1) and (3) were collected from cerebroid pine galls; other isolates were from fusoid galls.

collection from Tennessee. The degree of susceptibility of the pine selections had been determined by inoculating other progenies of these seed sources (the determinations were by the Institute of Forest Genetics at Gulfport). Three separate isolates of C. fusiforme were obtained from fusoid galls on loblolly or slash pine at each of five locations: (1) Nacogdoches, Texas; (2) Saucier, Mississippi; (3) Perry, Florida; (4) Auburn, Alabama; and (5) Raleigh, North Carolina. Eighteen 5- to 7-week-old seedlings of each pine selection were inoculated with each of the 15 rust isolates. Inoculation of the plants was accomplished with an apparatus that closely controlled spore deposition on each plant (Snow 1968). Seedlings were grown in the greenhouse and examined for galls 6 months after inoculation.

The susceptible slash and loblolly selections became uniformly infected by all rust isolates (table 2). The shortleaf seedlings were resistant to all the isolates.

Table 2.--Percentage of resistant and susceptible pine seedlings with fusiform rust galls 6 months after inoculation with Cronartium fusiforme from five geographic sources 1/

Selection of pine	Sources of inoculum				
	Texas	Mississippi	Alabama	Florida	North Carolina
	Pct.	Pct.	Pct.	Pct.	Pct.
Susceptible slash	96	96	100	100	96
Resistant slash	41	50	96	94	63
Susceptible loblolly	98	98	98	100	100
Resistant loblolly	63	62	63	39	35
Shortleaf	0	0	0	0	0

1/ Percentages were calculated for surviving plants of the 54 inoculated (three isolates from each source x 18 seedlings).

The resistant selection of slash pine showed moderate resistance to the Mississippi, Texas, and North Carolina isolates, but was highly susceptible to isolates from Alabama and Florida. Analysis of variance showed that this difference between sources was significant.

The resistant loblolly seedlings varied considerably in response to the individual isolates from each source, but the difference between sources was not significant.

Preliminary analyses of data taken 9 months after inoculation show that the trends described here have continued.

To summarize, we have found no evidence of variability in Cronartium fusiforme which is of a magnitude that can be detected with different species of pine. However, the differences which we have observed in the capacity of rust isolates to infect resistant within-species selections of pine indicate that pathogenic variation does exist in C. fusiforme. The importance of this variation in tree breeding programs remains to be determined.

LITERATURE CITED

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