Correlation Between Artificial and Natural Inoculation of Loblolly Pine with Southern Fusiform Rust

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ABSTRACT

As indicated by field plantings in two geographic areas, relative rust resistance of five loblolly pine progenies was accurately predicted by artificial inoculations of 1-yr-old seedlings. Artificial inoculation of 6-wk-old seedlings of the same progenies resulted in such heavy infection that genetic differences were largely obscured. Control of inoculum density seems necessary if very young seedlings are to be used as predictors of field performance.

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Additional key words: Cronartium fusiforme, Pinus taeda L., rust resistance, pathogenic variability.

Selection of pines resistant to the southern fusiform rust (*Cronartium fusiforme* Hedgc. and Hunt ex Cumm.) has been aided by the development of techniques for artificial inoculation. Such techniques make it possible to predict field performance of progenies in one growing season or less. Chiefly because of the length of time required, however, only a few comparisons have been made between field performance and evaluations based on artificial inoculation (2).

This note describes a comparison with seedlings inoculated at two ages and planted in three widely separated areas. Material of two ages was included to determine whether the genetic potential for resistance changes with age of progeny. Multiple field plantings were made to test the possibility of geographic variation in virulence of the inoculum (7).

MATERIALS AND METHODS.—Loblolly pine (*Pinus taeda* L.) seedlings from open-pollinated seed collected in five areas were inoculated in the spring of 1966 by the technique of Jewell and Mallett (4). Some of the seedlings were 6 wk old and some were 1 yr old. At about the same time, healthy seedlings of the same progenies were planted in replicated tests in southeastern Louisiana and central Mississippi.

Sample populations were chosen to insure a high probability that genetic differences in rust resistance would be found. Two areas were west of the Mississippi River and were expected to produce more resistant seedlings than the other three, which were in Alabama (8). Seed was collected from three to five individual trees at each area and individual-tree progenies (half-sib families) were kept separate.

There were some weak indications of family differences within areas, but area mean effects were much larger. Because the number of seedlings per family was small (11-15 in the 1-yr-old stock, 16-27 in the 6-wk-old stock), only area means will be considered further.

The inoculations were made at the Harrison Experimental Forest near Gulfport, Mississippi. The technique consisted of suspending telia-bearing oak leaves over pine seedlings in a shed where temp and humidity were controlled (4). The 6-wk-old material was growing in 25.0-mm square paper "plant bands" and the 1-yr-old trees were in 20.3-cm pots when inoculated. The tests were not replicated within the inoculation sheds; but in previous work with 6-wk-old material over a 10-yr period, repeatability has been high (4).

Final determination of infection was made after 1 yr in the nursery. The area-progenies inoculated at age 6 wk were represented by 61-124 seedlings and area-progenies inoculated at age 1 yr by 41-74 seedlings.

The Louisiana planting was scored at age 4 yr and the other two at age 5 yr. At those times, area-progenies were represented by about 90 seedlings in the Louisiana planting and about 15 in Mississippi. The data from both plantings were subjected to analysis of variance and Tukey's multiple range test, $P = 0.05$. Overall incidence of infection was 43% in Louisiana and 23% in Mississippi.

Because of differences in family-plot size, infection was measured in terms of proportion of infected trees per plot in the artificially inoculated material, and in terms of average number of cankers per tree in the field plantings. These indices have been shown to give similar

TABLE 1. Rust infection in loblolly pine progenies subjected to artificial and natural inoculation.

Seed-collection area	Artificial inoculation at age–				Natural inoculation[z] in–			
	6 wk		1 yr		Louisiana		Mississippi	
	(%)	(rank)	(%)	(rank)	(galls/tree)	(rank)	(galls/tree)	(rank)
SW Alabama	85	3	53	1	2.5 a	1	1.6 a	1.
West-central Alabama	90	1	30	2	1.2 ab	2	.8 ab	2.
NW Alabama	88	2	22	3	.4 bc	3	.2 b	3.
NE Louisiana	82	4	13	4	.2 c	4	.0 b	3.5
NE Arkansas	66	5	3	5	.0 d	5	.0 b	3.5

[z]Means with the same letter do not differ significantly ($P = 0.05$). The artificial inoculations were not replicated.

results (1). "Cankers per tree" was transformed to $\sqrt{\text{cankers per tree} + 1/2}$ for analysis.

RESULTS AND CONCLUSIONS.—Area-progenies ranked the same in the two field plantings and in the material inoculated at age 1 yr (Table 1). Those from west of the Mississippi River were least infected, as predicted, and infection increased from north to south among those from Alabama. Thus, artificial inoculation of 1-yr-old material gave reliable results.

Artificial inoculation of cotyledonary-stage seedlings resulted in so much infection that genetic differences among area-progenies were largely obscured. Only the very resistant seedlings from northeastern Arkansas were discernible from the others. Apparently inoculum density in the shed was too high for a definitive test at the suceptible cotyledonary stage. Techniques such as those developed by Snow (6), Dwinell (3), or Matthews and Rowan (5) probably would yield better results, since they permit control of inoculum density.

The progenies reacted similarly to inoculum at the two field sites and in the inoculation shed near Gulfport. This observation suggests that for loblolly pine, at least, no important differences exist in the pathogen at these three places. Snow et al. (7) also found little variability in the pathogen when the host was loblolly pine.

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