ARTIFICIAL TESTING OF INTRA- AND INTERSPECIES SOUTHERN PINE HYBRIDS FOR RUST RESISTANCE

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At the Southern Institute of Forest Genetics, research on disease resistance has been concentrated on Cronartium fusiforme, the southern fusiform rust. This rust continues to be a serious problem in southern forest tree nurseries and in plantation establishment and management .

The main purpose of the research is to determine how much variations it rush resistance occurs in southern pines and to what extent differences are heritable. The current program includes studies on intraspecific slash pine progenies from both rust-free and rust-infected parents. In addition, interspecific crosses have been made between, the highly resistant shortleaf pine and the susceptible slash and labially pines.

In most of the testing for resistance, cotyledon-stage seedlings have been artificially inoculated by techniques similar to those previously reported (5). Initially, tests were with one-parent progenies of rust-free slash pines. Parents yielding progenies with indications of resistance have been used for intraspecific breeding among themselves and with rust-infected parents.

In 1959, 80 progenies from each of 4 types of intraspecific slash pine crosses were tested in 5 randomized blocks, The parental cross-types were free x free, free x. infected, infected x free, and infected x infected. Six weeks after inoculation, 91 to 100 percent of the progenies had leaf symptoms; there were no significant differences among the cross-types. In 7 months following inoculation, all progenies of infected parents were galled, while 91 percent of the free x free progenies had galls. None of the differences among cross-types were statistically significant.

A similar test in 1960 utilized 180 progenies from each of 3 parental cross-types: free x free, infected x free, and infected x infected. Leaf symptoms appeared on 99 percent of the progenies in 6 weeks. At 7 months after inoculation 67 percent of the free x free progenies were galled, as compared to 96 and 99 percent of the infected x free and infected x infected progenies. The free x free progenies were significantly (at the 5-percent level) less susceptible. Table 1 summarizes the results from the free x free crosses inoculated in 1960. Although the percent of progenies with foliar symptoms

Table 1.--Infections following artificial inocu lation, with C. fusiforme, of intraspecific slash pine progenies from rust-free parents

Parent tree numbers ♀	♂	Inoculated	Six weeks after inoculation		Seven Months After Inoculation	
			Living	Proportion with leaf symptoms	Living	Proportion with stem galls
		Number	Number	Percent	Number	Percent
18-27	18-14	39	32	97	32	53
8-7	18-14	9	8	100	8	25
17-11	9-2	36	21	100	21	52
18-27	9-2	29	27	100	27	48
11-6	18-14	42	37	100	37	97
11-6	8-7	25	18	100	18	94

was uniformly high for all crosses, the percentage of progenies ultimately galled was, in most cases, considerably smaller. The exceptions wee progenies from 2 crosses having a common female slash pine parent, 11-6; in these, about the same proportion were galled as had exhibited symptoms. The data suggest that parent 11-6 transmits high susceptibility. This is further emphasized by the fact that when parents 8-7 and 18-14 were crossed with each other and parents other than 11-6, the percent of galled progeny was considerably reduced. The main point of interest from the intraspecies tests is the rather strong suggestion that crossing carefully selected rust-free parents may result in progenies with some degree of resistance.

Also tested in 1960 were progenies from 4 slash x shortleaf crosses, 1 shortleaf x slash, and 1 shortleaf x loblolly cross. Results are summarized in Table 2. Foliar symptoms, similar to those described on slash pine (5), were present 6 weeks after inoculation on 41 to 95 percent of the progenies. Galls, macroscopically typical for fusiform rust, subsequently formed on some progenies from each interspecies cross. In earlier trials (3,4) artificial inoculation of similar interspecies shortleaf hybrids resulted in foliar symptoms but no gall development; and field-planted shortleaf x loblolly hybrids have remained free of fusiform rust through 5 years of field exposure in an area of high rust incidence (1). Nevertheless, in the present study the symptom-bearing needles and the resulting galls had characteristic hyphae and haustoria of C. fusiforme (2) when examined under the microscope.

Not only did artificially inoculated interspecific shortleaf hybrids develop fusiform rust galls, but there were large differences in the proportion of galled progenies among the crosses (Table 2). In 3 crosses where shortleaf tree 2-1 was either the male or female parent the proportion of galled progenies was much higher than in the 3 cases where 2-1 was not involved. Thus different degrees of resistance, or susceptibility, appeared to be transmitted by the different shortleaf parents.

While the numbers of progenies in these interspecies tests are small, the results nevertheless establish that crossing slash or loblolly with shortleaf will not consistently yield resistant progenies. It now appears that resistance in shortleaf hybrids is more complicated than the simple dominance for resistance in shortleaf that had previously been assumed (3).

Table 2. - -Infections following artificial inoculation of pi ne hybrids with C. fusiforme.

Parent tree numbers	Species crossed	Inoculated	Six weeks after inoculation		Seven months after inoculation	
			Living	Proportion with leaf symptoms	Living	Proportion with stem galls
		Number	Number	Percent	Number	Percent
11-6 2-1	Slash x shortleaf	22	22	95	19	89
18-28 2-3	" "	11	11	91	11	18
8-7 2-3	" "	22	22	41	22	4
18-28 2-1	" "	43	42	93	40	92
2-1 11-16	Shortleaf x slash	155	139	100	127	87
2-5 18-23	Shortleaf x loblolly	10	9	88	9	22

Literature Cited

1. Henry, B. W., and Bercaw, T. E. 1956. Shortleaf-loblolly hybrid pines free of fusiform rust after 5 years' exposure. Jour. Forestry 54.

2. Jewell, F. F. 1958. Stain technique for rapid diagnosis of rust in southern pines Forest Sci. 4. 42-44.

3. 1959. Disease resistance studies in tree improvement research. Proc. Fifth South. Forest Tree Impr. Conf., pp. 18-20. Raleigh, N.C.

4. and Henry, B. W. 1959. Breeding for resistance to southern fusiform rust. Proc. Ninth Internat. Bot. Cong., pp. 181-182. Montreal, Canada.

5. Jewell, F. F. 1960. Inoculation of stash pine seedlings with Cronartium fusiforme. Phytopath. 50:48-51.