THIRD-YEAR COMPARISONS OF LOBLOLLY AND SLASH PINE SEED SOURCES FOR FUSIFORM RUST RESISTANCE AND GROWTH POTENTIAL IN NORTH CENTRAL FLORIDA

John A. Pait, III, Lee Draper, Jr., and Robert A. Schmidt 1/

ABSTRACT

Four loblolly and three slash pine seed sources were evaluated for rust resistance and growth potential in a provenance test established in 1981 in a high rust incidence area in northcentral FL. The site was moderately well-drained and the soil was a sandy loam overlying clay at 24 inch depth; site index was 75 ft at 25 years. Loblolly pine seed sources were East Texas, Livingston Parish, Marion County, FL and FL seed orchard. Slash pine seed sources were FL and GA seed orchards and a rust-rogued seed production area in North FL. Survival, diameter, height and rust incidence (% trees with one or more galls) were measured after the third growing season. Seed sources within species only were compared statistically. Within loblolly sources, survival, diameter and height were greatest in Marion County and least in East Texas; Livingston Parish and FL seed orchard were intermediate. All loblolly sources were significantly different for rust incidence. East Texas was least rust-infected (9.6%), Livingston Parish was intermediate (21.0%), Marion County was highly infected (50.6%), and the Florida seed orchard source was the most infected (68.7%). Within slash pine sources survival, diameter and height were greater in the seed orchard sources than in the rust-rogued seed production area, but the latter had significantly less rust (27.4%) compared with 59.0% and 61.7% for the FL and GA orchards, respectively. For loblolly sites in this area recommendations are to plant East Texas sources on the highest rust incidence sites, Livingston Parish sources on the intermediate rust incidence sites and Marion County sources in eastern area where rust incidence is low. For slash pine sites where rust incidence is high, seed from the rust-rogued seed production area is recommended.

Additional Keywords: *Pinus elliottii* var *elliottii*, P. *taeda*, *Cronartium quercuum* f. sp. *fusiforme*, disease resistance, provenance tests.

1/ Research Foresters, Container Corporation of America, Timber Research and Development, Callahan, Florida, 32011, and Professor of Forest Pathology, Department of Forestry, University of Florida, Gainesville, 32611, respectively.

INTRODUCTION

In areas where the incidence of fusiform rust, caused by *Cronartium quercuum* f. sp. *fusiforme*, is great forest managers must consider alternatives to reduce the impact of this disease (Schmidt et al. 1977,

Schmidt and Klapproth 1982, Anderson et al. 1984). Currently, the primary means of mitigating the epidemic in high rust incidence areas is planting rust-resistant seed sources (Schmidt et al. 1985). Several sources of resistance are available. These include Livingston Parish and East Texas provenances of loblolly pine and rust-rogued seed production areas for slash pine (Goddard and Wells 1977, Schmidt et al. 1981). Recommendations for a specific area must consider both growth and rust response. Decisions are best made with data obtained from tests established in the immediate area, since both growth and disease resistance (perhaps pathogenic variability) vary geographically (Draper 1975, Powers and Matthews 1980, Pait and Draper 1983). The objectives of this study were to compare the growth and rust resistance of several loblolly and slash pine seed sources in a high rust incidence area in North Central FL for the purpose of providing management recommendations.

METHODS AND MATERIALS

Location and Site Characterization. The seed source test is located in North Central FL in Marion County, approximately ten miles northwest of Ocala. The soil is a moderately well-drained, fine sandy loam overlying clay at a 24 inch depth. Site index is 75 ft at 25 years for loblolly and slash. Fusiform rust is considered a serious problem in this location, e.g., rust incidence on a seven-year-old loblolly plantation in this area exceeded 75% of the trees infected.

Seed Sources. Four sources of loblolly and three sources of slash pine seed were planted. These sources represented the best regeneration alternatives at the time and all were bulk seed collections. The loblolly pine sources were from 1) East Texas 2) Livingston Parish, and 3) Marion County, FL provenances, and 4) Container Corporation of America's (CCA) loblolly seed orchard selections. The slash pine sources came from CCA's 1) GA slash pine seed orchard, 2) FL slash pine orchard, and 3) a rust-rogued seed production area in Madison County, FL. Seed orchard sources of both species were generally unimproved for rust resistance. The East Texas and Livingston Parish provenances were known to contain appreciable rust resistance (Wells and Wakely 1966, Wells and Switzer 1975) and the Marion County provenance has shown good growth and, on occasion, some rust resistance (Draper, 1975). The rust-rogued slash pine seed production area was located in a high rust incidence area in Madison County, FL and was expected to have considerable rust resistance (Goddard et al. 1975), but was not previously tested in an appropriate trial.

Site Preparation and Planting: Sites were prepared by pushing debris from the area of the plots, followed by single drum chopping and burning. In January 1981 seedlings were hand-lifted from the nursery at Archer, FL and dibble-planted at a spacing of 5.5' x 12' (660 trees/acre).

Study Design. The study design was a randomized complete block. Within species each seed source was randomly planted in each of nine replications (plots). Each plot consisted of 130 seedlings (10 rows of 13 seedlings each.) Species were analyzed separately since they were not mixed, and were separated by a fire break.

Maintenance and Data Collection. In May of 1982 hardwood sprouts, which threatened survival and growth, were killed with cut-surface application of Banvel CST. The strips between the rows were mowed in the summer of 1982 and 83.

After the third growing season (October 1983) survival, DBH, total tree height and rust incidence were measured. Rust incidence was recorded on the total number of living trees and included trees with 1) stem galls only, 2) branch galls only, and 3) both branch and stem galls. Rust associated mortality averaged < 1% and was excluded from the analyses. Within species data were analyzed with the general linear models procedure for analyses of variance (Statistical Analysis System) and seed source means were compared with Duncan's Multiple Range test (p <

RESULTS

Survival, Height and DBH (Table 1).

Loblolly. The four loblolly pine seed sources averaged 77.3% survival, 6.6 ft in height and 0.78 inches DBH. There were significant differences among seed sources for each of these parameters. The Marion County source performed best and the East Texas source performed the poorest; the Livingston Parish and FL seed orchard sources were intermediate.

Slash. The three slash pine seed sources averaged 77.6% survival, 5.9 ft in height and 0.92 inches DBH. There were significant differences among seed sources for each of these traits. Generally, the FL and GA seed orchards sources performed the best and the seed production area source performed the poorest for these growth traits.

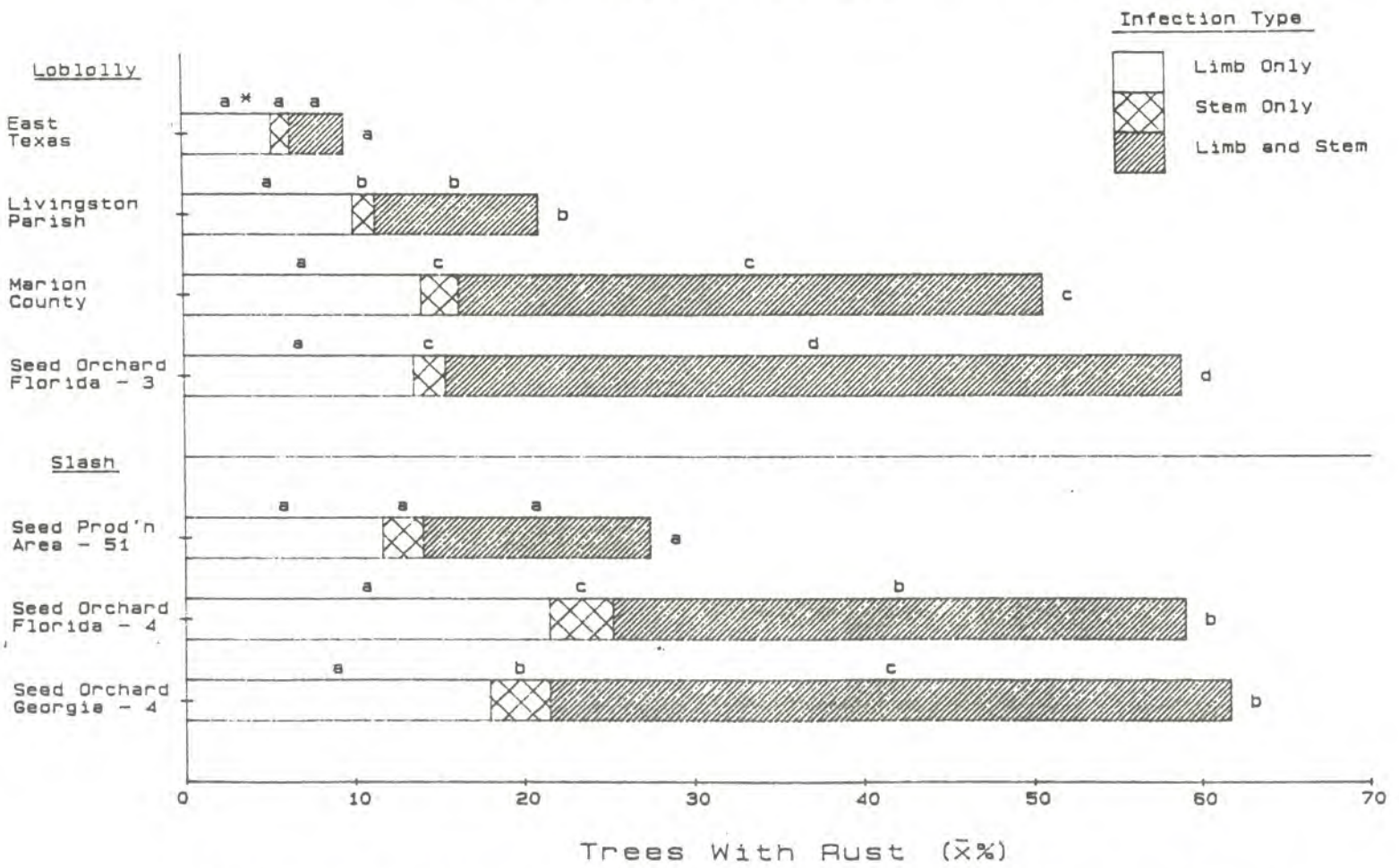
Table 1. Comparison of mean survival, DBH and height at age 3 years for loblolly and slash pine seed sources planted in Marion Co., Florida.

Species	Source	Survival (%)	DBH (inch)	Height (ft)
Loblolly	Marion County, FL	83.4 a2/	0.87 a	7.2 a
	FL Seed orchard	73.7 c	0.78 b	6.8 b
	Livingston Parish	79.2 b	0.78 b	6.5 c
	East Texas	72.9 c	0.69 c	5.8 d
Slash	FL Seed orchard	74.6 b	0.97 a	6.2 a
	GA Seed orchard	80.9 a	0.93 a	6.1 a
	Seed production area 1/	74.6 b	0.85 b	5.5 b

1/ Rust-rogued and located in a high rust incidence area in Madison County, FL

2/ Statistical comparisons are within a parameter (column) among seed sources within species; means followed by different letters are significantly different (Duncan's Multiple Range Test,(p 0.05)

Figure 1: Mean percentage of live trees with rust galls at age three for pine seed sources planted in Marion County Florida



*Total rust infection (bar lengths) and infection types among seed sources and within species are not significantly different if accompanied by similar letters according to Duncan's Multiple Range Test ($p \leq .05$).

Fusiform Rust (Figure 1).

Loblolly. The four loblolly pine seed sources averaged 1.6% stem galls only, 10.8% limb galls only, 25.1% both limb and stem galls, and 37.5% total rust infected live trees. Average rust associated mortality among these sources was ≤ 1%. The mean total rust incidence on live trees was 9.6, 21.0, 50.6 and 68.7% in the East Texas, Livingston Parish, Marion County and FL seed orchard sources, respectively. Rust incidence was significantly different for each loblolly source.

Slash. The three slash pine seed sources averaged 3.2% stem galls only, 17.1% limb gall only, 29.1% both limb and stem galls and 49.4% total live trees with rust. The mean total rust incidence on living trees was 27.4, 59.0 and 61.7% in the seed production area and FL and GA seed orchards sources, respectively. The seed production area source exhibited significantly less rust than the seed orchard sources.

DISCUSSION

Average survival (loblolly, 72.4-83.4%; slash, 74.6-80.4%) and average rust incidence (loblolly, 9.5-68.7%; slash 27.4-61.7%) were sufficient for a reliable test of these seed sources. Growth rankings among sources may change with time and these data must be considered preliminary. Rust incidence will increase with time, but it is unlikely that relative rankings among seed sources will change.

As suggested in earlier tests (Draper 1975, Pait and Draper 1983) the Marion County source has superior growth in this area, as well as in some northern areas. The East Texas and Livingston Parish sources grew more slowly corroborating age five results published previously (Pait and Draper 1983). The slash pine seed orchard sources grew significantly better than the seed production area source. Among the seed sources, survival, height and DBH variation was greater in loblolly than in slash pine.

Rust incidence on the East Texas source was significantly less than all other loblolly sources. Similar results were reported by Pait and Draper (1983) for this and other areas in FL and GA. Although a statistical comparison was not appropriate - due to the experimental design - the East Texas source was less infected than all slash pine sources. Livingston Parish exhibited good rust resistance in this area, but other data (Pait and Draper 1983) suggests this source is very susceptible when planted in Madison County, FL, 100 miles northwest of Marion County, FL. The reason for the poor performance of Livingston Parish in the earlier study is not known.

As was reported by Goddard et al. (1975) the seed from heavily infected rust-rogued stands possess substantial rust resistance. This was substantiated here as the seed production area source was significantly less infected than the other slash pine sources. In fact, the rust-rogued seed production area source performed nearly as well for rust resistance as the Livingston Parish source. In the absence of rust improved orchard seed and resistant provenance sources, seed from rust-rogued slash pine seed

production areas provides a good alternative for planting in areas of high or intermediate rust incidence.

Despite a report (Schmidt et al. 1985) that rust incidence is higher on loblolly than on slash pine in this geographic area, susceptible loblolly (68.7%) was only slightly more infected than was susceptible slash pine (60.4%).

CONCLUSIONS

Among the loblolly sources East Texas had significantly less fusiform rust, but also had the poorest survival and growth. The Livingston Parish source was intermediate in rust incidence and growth. The Marion County source grew best, but had significantly more rust than either the East Texas or the Livingston Parish source. The seed orchard source had significantly more rust than all other sources and was intermediate in survival and growth.

Among the slash pine sources the rust-rogued seed production area had significantly less rust than the seed orchard sources. In fact the resistance of the rust-rogued seed production area source compared favorably with the Livingston Parish source, although a statistical comparison was not appropriate because of the experimental design.

Indications from these early observations, combined with information from previous tests suggest the following seed source allocation.On loblolly sites East Texas and Livingston Parish sources should be utilized on the high and intermediate rust incidence areas, respectively. The Marion County source should be restricted to the eastern portion of this area where rust incidence has been low. On slash pine sites the seed production area source should be planted in the high and intermediate rust incidence areas and the seed orchard sources elsewhere on the low rust incidence areas only.

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