

FIFTH YEAR PERFORMANCE OF WIDE RANGING
LOBLOLLY PINE PROVENANCES

John A. Pait, III and Lee Draper, Jr.^{1/}

Abstract.-- Five provenances of loblolly pine were planted at six locations in north Florida and south Georgia. After five growing seasons, the East Texas source had the lowest fusiform rust infection in most tests and exhibited fair growth rate. The Livingston Parish source incurred surprisingly high rust infection, but generally ranked well in growth. Marion County, Florida and north Florida Seed Orchard stock grew well, but sustained high rust infection. The Eastern Shore of Maryland source was intermediate to East Texas and Livingston Parish in rust infection, but ranked lowest in growth in most tests. Livingston Parish and local sources are not recommended for planting in high rust hazard areas.

Additional keywords: Pinus taeda, Cronartium quercuum f. sp. fusiforme resistance, geographic variation.

The use of loblolly pine (Pinus taeda L.) in Container Corporation of America's regeneration efforts has steadily increased in the past 20 years. In 1982 and 1983 more than half of Container's reforestation was devoted to this species. Early decisions concerning the best loblolly seed sources for Company lands were made based on the Southwide Pine Seed Source (Wells, 1969) and in-house provenance tests (Draper, 1975). These studies indicated that the best provenances for use in north Florida and south Georgia were Marion County, FL, Livingston Parish, LA, and East Texas. To best use these sources on Company lands, a partial combination of the Southwide Study and our in-house tests was required. The result was the installation of several tests across CCA lands in 1976 and 1977. Fifth year measurements suggest continued use of all three aforementioned provenances with changes in geographic allocation that should minimize fusiform rust (Cronartium quercuum f. sp. fusiforme) infection and maximize growth rate,

^{1/} Assistant and Senior Research Forester, respectively, Container Corporation of America, Timber Research and Development, Callahan, Florida.

The authors express their sincere thanks to Brunswick Pulp and Land Company for the establishment and measurement of the Liberty County, Georgia test. We also thank Patricia Layton, University of Florida, for her assistance in data analysis.

METHODS

Seed Sources and Test Establishment

The objective of the study was to evaluate East Texas, Livingston Parish, Marion County, FL, northeast Florida, and Eastern Shore of Maryland sources for reforestation on a variety of loblolly pine sites in north Florida and south Georgia.

East Texas seed was provided by Southwestern Lumber Corporation. Seed from the eastern third of Livingston Parish, LA was provided by the United States Forest Service (courtesy of O. O. Wells). Seed from the eastern half of Marion County, FL was collected following a logging operation. Seed representing northeast Florida came from an unrogued, first generation seed orchard composed of northeast Florida and southeast Georgia selections. Seed from the Eastern Shore of Maryland was provided by the Chesapeake Corporation. These five sources were sown in Container's nursery near Archer, FL in the spring of 1975.

During the dormant season of 1975-76 seedlings of each of the five sources were lifted and dibble planted in Madison, Marion, and Nassau Counties, Florida and Randolph, Telfair, and Liberty Counties, Georgia (Figure 1). The test design consisted of a 49 tree (seven rows X seven trees per row; spacing of 6 feet X 10 feet) rectangular plot of each source randomly assigned to each of four replications (196 trees per source per test). ~~For initial~~ survival due to drought necessitated re-peating the Marion County, FL and Randolph County, GA tests in the 1977 planting season. By accident, seed orchard slash pine was planted in the Marion County, FL and Randolph County, GA tests instead of the north Florida - south Georgia seed orchard (SO) source. Their performance will not be discussed.

Measurements and Analyses

Fusiform rust infection, survival, total height, and diameter at breast height were tallied in five of the six tests at age five. Only total height and rust infection were measured in the Liberty County, GA test. No distinction was made between stem and limb rust infection in any of the tests.

Since source-performance at each location was of primary interest, analyses of variance were conducted for each parameter within each test. Source means within each test were separated using Duncan's multiple range test at the 0.05 level of probability.

Figure 1:

CONTAINER CORPORATION OF AMERICA LOBLOLLY PINE PROVENANCE TESTS



Seed Sources:

- E.T. - East Texas
- L.P. - Livingston Parish
- M.C. - Marion County
- S.O. - North Florida Seed Orchard
- E.S. - Eastern Shore Of Maryland

Plantations:

- A - Madison County, FL
- B - Marion County, FL
- C - Nassau County, FL
- D - Randolph County, GA
- E - Telfair County, GA
- F - Liberty County, GA

- - - - : Dashed line delineates natural range of loblolly pine.

RESULTS AND DISCUSSION

Fusiform Rust

Average fifth year fusiform rust infection ranged from 6.0% (Nassau County, FL) to 44.9% (Madison County, FL). Significant source differences were present in all but the lightly infected Nassau County, FL test (Figure 2a.). The East Texas incurred the lowest infection rate in all tests except Nassau County, FL. The Eastern Shore of Maryland and Livingston Parish sources sustained relatively low and similar infection rates except in Madison County, FL. In this test, the Livingston Parish source was the most highly infected of all ; 73.5% versus 14.3% and 24.5% for East Texas and Eastern Shore of Maryland sources, respectively. The Seed Orchard and Marion County, FL sources sustained the highest levels of infection in the Telfair and Liberty Counties, GA tests. The Seed Orchard source was highly infected relative to other sources in the Liberty County, GA test; 65.4% versus 39.1%, 30.8%, 28.2%, and 17.8% for the Marion County, Eastern Shore of Maryland, Livingston Parish and East Texas sources respectively. The Marion County source was severely infected in the Marion County, FL test; 60.1% versus 16.7%, 16.3% and 7.6% for the Eastern Shore of Maryland, Livingston Parish, and East Texas sources respectively.

It is unclear why the Livingston Parish source was so highly infected relative to the other resistant sources in the Madison County, FL test. One explanation is the possibility of interaction between its source and local sources of rust spores. Considerable pathogenic diversity in fusiform rust has been reported to exist among diverse geographic areas, among galls within the same area, and within a single gall (Schmidt et al, 1981). Variation in rust resistance within Livingston Parish may have contributed to the source's high rates of infection. If so, more specific information on seed origin will be required for use of this source in high rust areas.

Use of local sources in high hazard rust areas is not recommended. Pathogenic adaptation to local sources has been demonstrated artificially (Powers et al , 1977 and Powers and Matthews, 1980) and recently reported with respect to the Southwide Pine Seed Source Study (Wells, 1983). The 60.1% level of infection in the Marion County source and light infections in other sources planted in the Marion County, FL test (Figure 2a.) further corroborate such findings.

Survival

Average fifth year survival ranged from 65.4% (Telfair County, GA) to 97.3% (Nassau County, FL). Significant source

Figure 2a:

Fifth year fusiform rust infection by seed source and test plantation.^{a)}

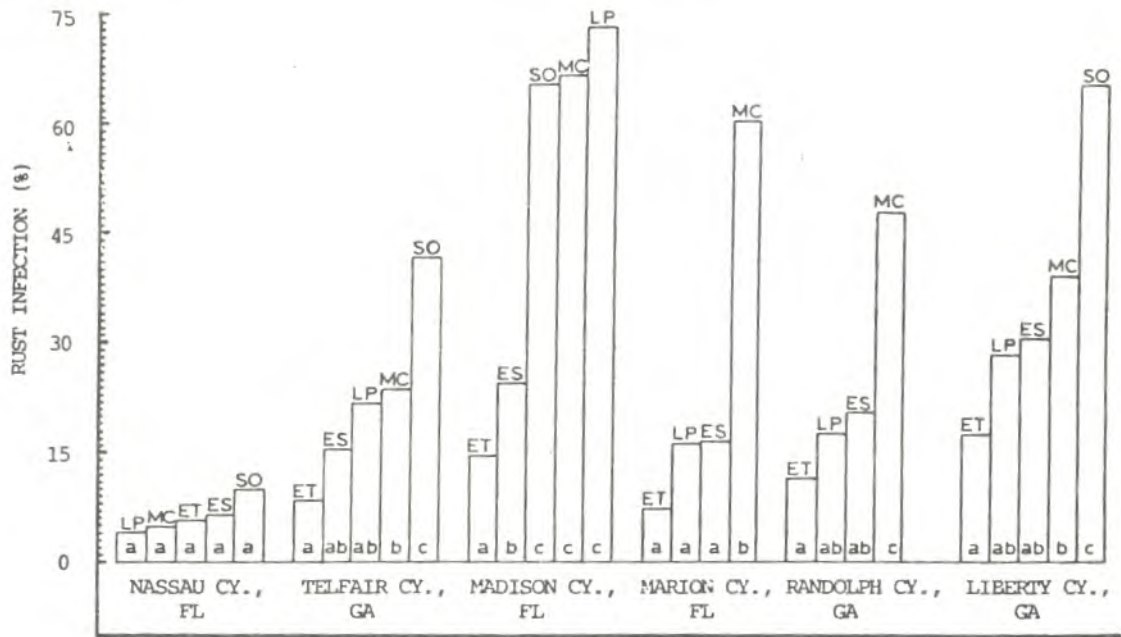
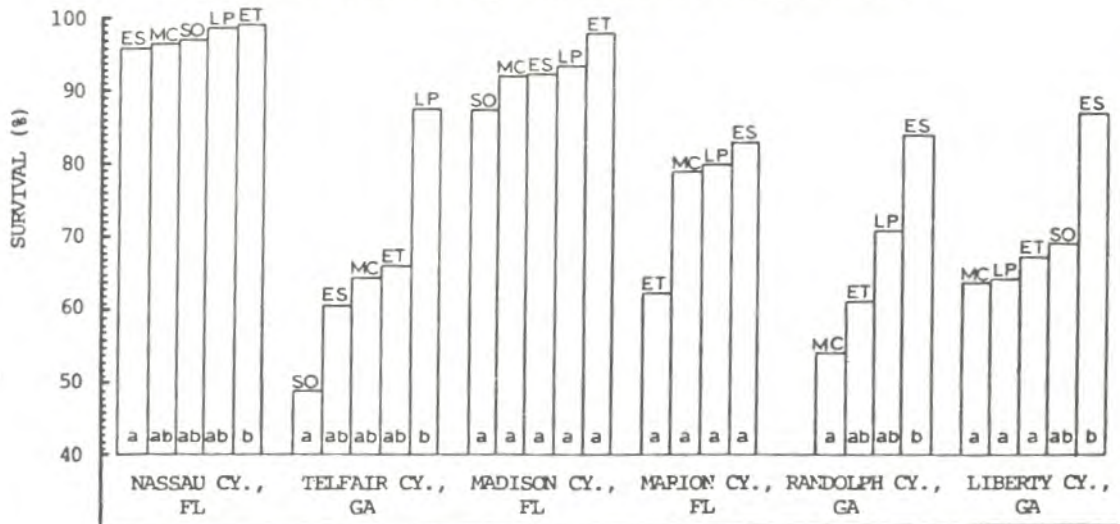


Figure 2b:

Fifth year survival rates by seed sources and test plantation.^{a)}



^{a)} Bar heights (source means within test) enclosing similar letters are not significantly different according to Duncan's multiple range test; 0.05 level of probability.

differences were present in all but the Madison County and Marion County, FL tests (Figure 2b.). Generally these differences were only significant between the highest and lowest survival rates. The poor survival of most sources in the Telfair and Randolph Counties, GA tests was due to drought following planting. Feral pigs caused considerable damage in some plots of the Liberty County, GA test. This may explain the fairly low survival rates of all sources except Eastern Shore of Maryland sources (86.2%).

Height

Average fifth year heights ranged from 8.0 feet (Nassau County, FL) to 13.5 feet (Madison County, FL). Significant source differences were present in all but the Liberty County, GA test (Figure 3a.). The Livingston Parish source was tallest in three of the six tests but never significantly different from the East Texas source. The Marion County source was significantly tallest in the Marion County, FL test. The Eastern Shore of Maryland source ranked last in five of the six tests; it was significantly shortest in three of the five.

Diameter

Average fifth year diameters at breast height ranged from 1.3 inches (Nassau County, FL) to 2.7 inches (Madison County, FL). Significant source differences were present in all but the Nassau County, FL test (Figure 3b.) and Liberty County, GA test (not measured). The Eastern Shore of Maryland source was significantly smallest in the Madison County and Marion County, FL tests in which it was also the shortest. The Livingston Parish source in Madison County, FL was the largest of all sources in all tests (3.2 inches). The Marion County source was significantly the largest of all sources in the Marion County, FL test.

CONCLUSION

Although the data pertain to young tests several trends are clear. The best of the five sources for planting in high hazard rust areas appear to be that from East Texas. This source exhibited surprising stability in rust resistance even in the Madison County, FL test where the Livingston Parish source incurred a 73.5% infection and East Texas only a 14.3% infection. Though the Eastern Shore of Maryland source is fairly rust resistant, its height and diameter performance indicate poor adaptation to north Florida or south Georgia.

Based on current findings, the Livingston Parish source is not recommended for high hazard rust areas. Where fusiform rust is not a major consideration, local, Livingston Parish or Marion County sources are recommended for planting within normally recognized latitudinal limits.

Figure 3a:

Fifth year total heights by seed source and test plantation. ^{a)}

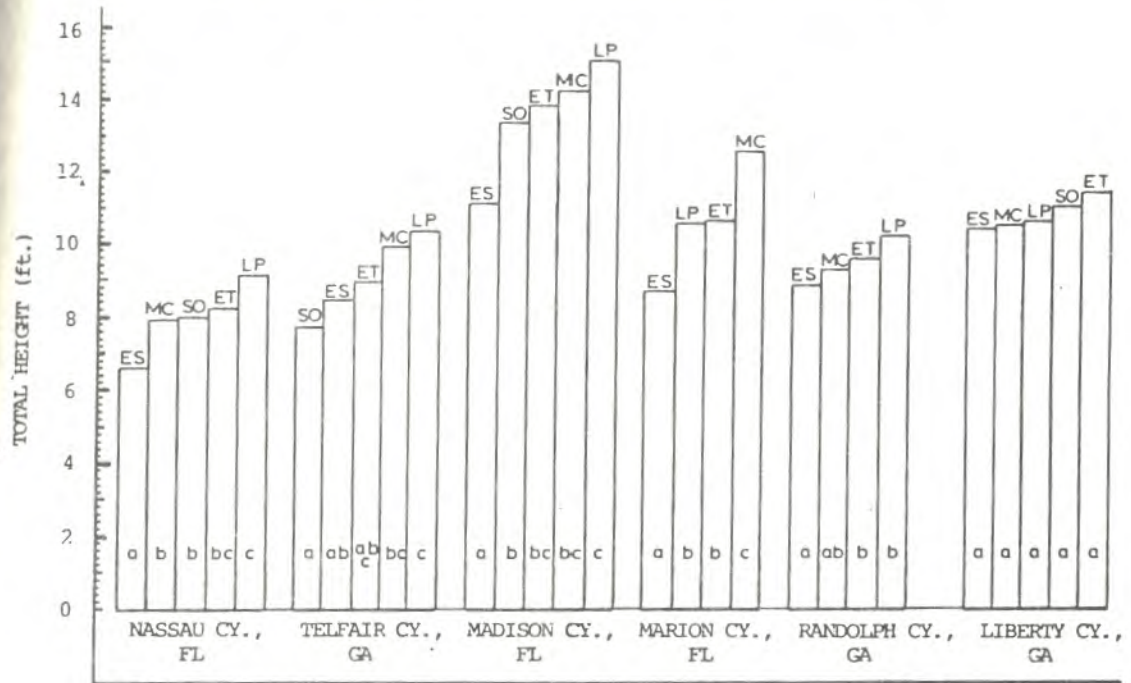
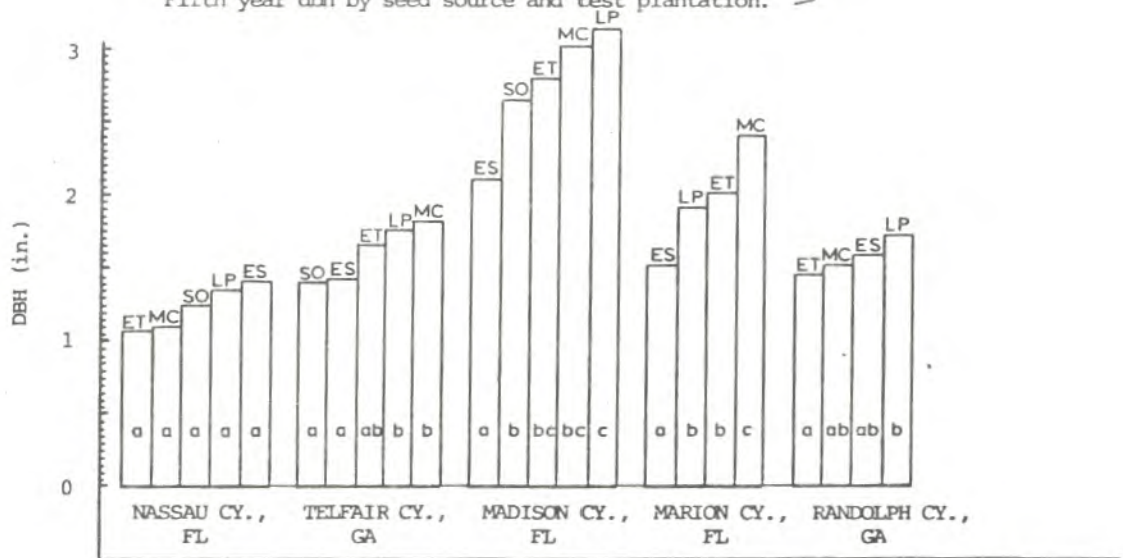


Figure 3b:

Fifth year dbh by seed source and test plantation. ^{a)}



^{a)} Bar heights (source means within test) enclosing similar letters are not significantly different according to Duncan's multiple range test; 0.05 level of probability.

LITERATURE CITED

- Draper, L., Jr. 1975. Provenance study of five geographic sources of loblolly pine. Pages 83-88 in : Proc. 13th South. For. Tree Improv. Conf., 10-11 June 1975, Raleigh, N.C. Published by South. For. Tree Improv. Comm. 262 pp.
- Powers, H. R., Jr., F. R. Matthews, and L. D. Dwinell. 1977. Evaluation of pathogenic variability of *Cronartium fusiforme* on loblolly pine in the Southern USA. *Phytopathology* 67 : 1403-1407.
- Powers, J. R., Jr., and F. R. Mathews. 1980. Comparison of six geographic sources of loblolly pine for fusiform rust resistance. *Phytopathology* 70 : 1141-1143.
- Schmidt, R. A., H. R. Powers, Jr., and G. A. Snow. 1981. Application of genetic disease resistance for the control of fusiform rust in intensively managed southern pine. *Phytopathology* 71 : 993-997.
- Wells, O. O., 1969. Results of the southwide pine seed source study through 1968-1969. Pages 117-129 in : Proc. 10th South. For. Tree Improv. Conf.
1983. Southwide pine seed source study --
loblolly
pine at 25 years. *South. Jour. App. For.* 7:2: 63-70.