FIVE YEAR GROWTH RESULTS OF WATER OAK (QUERCUS NIGRA L.) PROVENANCE

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Abstract.--A twelve origin, 68 family seed source study for the western range of water oak (Quercus nigra L.) was established in the field in 1982. Five year growth results are highly significant individual family variation for diameter growth and significant origin variation for height growth. No distinct geographic pattern was evident although the middle Mississippi River and middle eastern Mississippi sources were consistently the better sources for both traits. The southwest Louisiana source was overall the best preforming of the origins for height and growth.

Keywords: Quercus nigra L., provenance, height growth, diameter growth, genetic variation.

INTRODUCTION

Approximately 44 percent of the hardwood volume in the South is composed of various oak species (USDA 1988). Water oak (Quercus nigra L.) is an important component of this oak group. Although water oak is not considered one of the select red oaks as is cherrybark (Q. falcata var pagodaefolia Ell.) and Shumard (Q. shumardii Buck. L.) (Kingsey and Powell 1979), the species is important because of its extensive range, frequency of occurrence and many uses of the wood.

Water oak makes best growth on moist bottomlands and lower slopes of the uplands and is considered to be an intolerant subclimax associate of the bottomland forest (Fowells 1965). The species is not as site sensitive as some of the oaks and can be found making good growth on drier sites as a component of loblolly and shortleaf pine stands. Water oak does not tolerate inundation levels that its close relative willow oak (Q. phellos L.) does.

There is little published genetic information available on water oak. However, there are several progeny test in progress. Both the North Carolina State University-Industry Cooperative Research Program (Purnell and Kellison 1983) and the Western Gulf Tree Improvement Cooperative (Byram and et al. 1987) have some material in progeny test. These programs combine water and willow oak into a single group (water/willow).

Because there was almost no information available on water oak, this species was selected for study. The initial effort was provenance study of the western portion of the range of the species to look at genetic variation within the region for the species. Genetic variability among and within

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stands was also to be addressed, as was establishment techniques, cultural requirement, and maintenance problems associated with genetic test of the species.

METHODS AND PROCEDURES

In the fall of 1978, water oak acorns were collected from the western portion of the natural range of water oak. Twelve origins were located on approximately a 160 X 160km grid (Figure 1). Within these areas two distinct stands were selected and the first three trees having an acorn crop were collected. Sixty-eight family collections were made.

Acorns were cold, moist stored until the spring and were then planted in Spencer-Lemaire rootrainers for initial germination. After sufficient seedlings had germinated they were transplanted to outside nursery beds and planted on a 12 X 12cm (70 seedlings/m2) spacing.

The seedlings were grown in the nursery for two years. Bare root 2-0 stock was planted at two locations in February 1982. Height and groundline diameter measurements were taken at the end of the nursery phase. At age five in the field, height and diameters (DBH) were collected. One plantation was lost to natural causes during this period and this paper reports on the results of one outplant location at Vernon, Louisiana.

The design of the provenance study *was* a randomized block with a hierarchal arrangement of 12 locations, two stands within location and three trees within stand. The Statistical Analysis System (SAS 1982) was used to analyze all data.

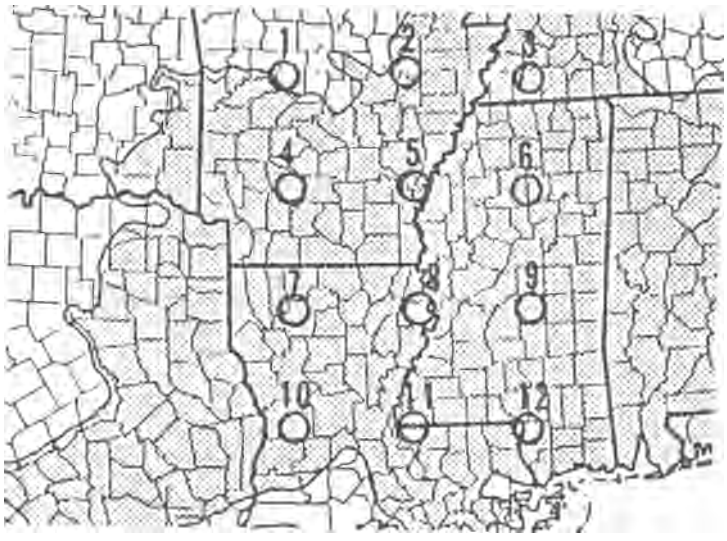

Figure 1. Western range of water oak and seed source collection areas (circles indicate areas) for the water oak provenance study.

RESULTS AND DISCUSSION

Survival was good (80 percent) in one plantation and extremely poor (< 59 percent) in the other. Therefore for the fifth-year results only the Vernon, Louisiana planting was used. During the first-year in the field problems were encountered with transplant shock (Adams 1988). However, seedlings recovered and assumed the approximate height and diameter rankings that existed at the end of the nursery phase.

The initial poor performance, the result of transplant shock, was followed in the subsequent years by good growth. Average height after the fifth year for the plantation was 3.75m and average diameter (DBH) was 3.58cm.

Genetic Variation

Among possible sources of variation, only individual family variation for diameter (DBH) ($P<0.01$) and origin variation for height ($P<0.05$) were significant (Table 1). There were no significant differences for origin or stand/origin variation for diameter. There were no significant differences found for stand/origin nor individual family variation for height growth. Also interaction were not significant.

Variational patterns were difficult to isolate. However, four sources (5, 6, 7, 8) located in the middle and east (Greenville, MS and 100 miles east; Vicksburg and 100 miles east) have consistently been among the best in height and diameter (Figure 1). The best origin for height growth, however, is the southwest Louisiana source (Fort Polk area). There is apparently no geographic pattern for diameter but the southwest Louisiana is also ranked number two for this trait.

Since origin variation was most pronounced for height and no within origin variation was noted, the families within origin appear to be more closely related and thus within origin selection gains for height will be more difficult. Selections, however, from the best seed sources should provide genetic improvement for height. The converse is true for diameter which is highly variable among individual families but there are no detectable origin difference. Selection gains should relatively easy because of the widespread variability of this trait.

Another characteristic not measured but observed, was the difference in leaf initiation in the spring between northern and southern sources. The northern Arkansas sources were 7-10 days later than the southern sources. Once during the past five years a very late freeze has severely damaged foliage of local and the southern sources. The later northern sources were not affected as leafing had not started.

CONCLUSIONS

Based on five years of field data there appears to be considerable individual variation for diameter growth. There does not appear to be a large amount of variation for individual tree height. However, there is a signifi-

cant origin difference for height which would indicate genetic gains could be made by concentrating selection in the best seed source areas.

Table 1. Nursery height, fifth year height and fifth year diameter (DBH) for a 12 origin, 69 family water oak provenance study.

Origin	Height 2-0 Nursery	Height 5th Year Field	Diameter 5th Year Field
	(m)	(m)	(cm)
1		3.52bcd	3.99ab
2	1.18abc	3.69abcd	3.72ab
3	0.99e	3.20d	4.35a
4		3.41cd	3.29ab
5	1.02de	3.71abcd	3.36ab
6	1.02de	4.01abc	3.45ab
7	1.10bcde	3.66abcd	3.13b
8	1.08cde	3.74abcd	3.57ab
9	1.09cde	4.11ab	3.68ab
10	1.23a	4.23a	4.05ab
11	1.12abcd	3.46bcd	3.19b
12	1.21ab	3.76abcd	3.36ab

[1]Means followed by the same letter in a column are not significantly different at the 0.05 level.

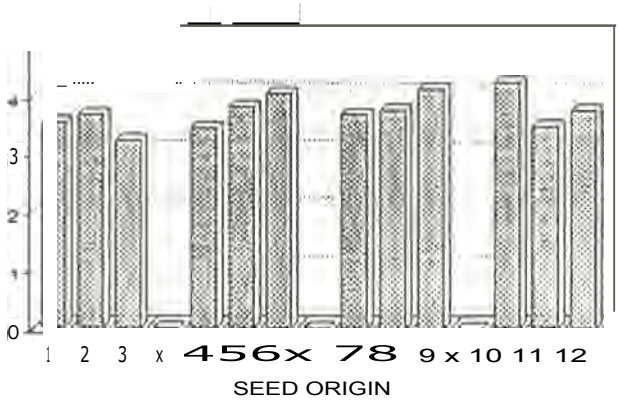

Figure 2. Mean height of 12 water oak seed origins. Low origin number - northern sources, high origin number - southern sources.

Several observations have been made while working with this species. They are:

1. The species exhibits dieback which can cause establishment problems (Adams 1986),
2. The species is fast growing once established,
3. The species is distinct but is confused with several other oak species and at least one hybrid,
4. The species will grow well on a variety of sites, and
5. Growth improvements can be made by selection from the best origins for height and best individuals for diameter.

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