Growth Trends Of Loblolly Pine On Two Drained Wetlands

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During the past 15 years, loblolly pine has been planted on thousands of acres of wet forest land altered by drainage. Those responsible for the drainage are concerned with how the trees are doing. Gradually we are developing the knowledge to determine this. Results from a recent study have helped by providing an example of growth under varied moisture and soil conditions. Growth was found to be better during a wet year, when water table levels were higher, than during a dry year, when lower water levels prevailed. Moreover, growth was also considerably better on a heavy soil than on a light soil.

The data were obtained from two representative drained wetland areas in Berkeley County, South Carolina, just west of Charleston. One case study area was a ridge bay formed between old beach lines as the ocean receded from the eastern seaboard in past geologic eras. Within the bay are found deep sandy soils. Further inland, the second wetland area used in this case study was another type of bay commonly referred to as a "Carolina Bay" which often has a characteristically heavy soil. Neither bay was accessible for logging prior to drainage in 1952-1955. After the over-story of pond pine on the ridge bay and cypress-hardwood on the Carolina Bay was removed, the areas were planted with loblolly pine seedlings.

Within each of the two bays, one 1/10-acre plot was established to index growth. The plots chosen were typical and contained 10- to 12-year-old loblolly pine trees in a healthy, vigorous condition, and growth responses could be easily detected. Height and diameter growth of five trees on each plot were measured every two weeks during the 1963 and 1964 growing seasons. In addition, bi-weekly measurements of water table levels and rainfall totals were made. Analysis of soil texture provided the information necessary for plot soil type identification. Plot data were analyzed in two ways to see if water table levels were correlated with growth. First, total growth and average water table levels for the 1963 growing season were compared to those for 1964 and, secondly, increment growth within each growing season was compared with bi-weekly water levels.

The plot in the ridge bay was positioned on a slight rise and contained soil typed as Plummer loamy sand. Loblolly survival and growth in that portion of the bay had not been particularly good, and it was necessary to select an elevated location to obtain vigorous trees. The plot in the Carolina Bay was located on Bayboro clay loam on a slope at the edge of a cypress pond that was still too wet in the center to support pine trees (Figure 1).

Tabulation of rainfall records and water table data for the two growing seasons demonstrated quite different moisture conditions prevailed between the two years, with 1963 dry and 1964 wet. At the same time, diameter growth on both plots was 100 per cent greater in the wet

FIGURE 1.—*Twelve-year-old loblolly pine growing on the edge of a drained pond that in its natural state supported only cypress (extreme left).*

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year than the dry one, and height growth was 20 per cent greater. For both years, diameter and height growth on the clay loam plot was more than double that for the loamy sand plot (table 1).

Statistical comparisons between growth and water conditions within a growing season followed the same pattern as seasonal comparisons, i.e., growth was better during wet periods than dry periods. However, this relationship was true only for diameter growth and then only in the dry (1963) growing season. But water table levels are not the only influence on diameter growth; statistical analysis of the data showed that less than 40 per cent of the growth was accounted for by fluctuations in the water table.

Favorable location of the plots within each wetland area could explain, in part, the growth patterns demonstrated by the trees, particularly in the wet year. The ridge position of the Plummer plot and slope position of the Bayboro plot made surface flooding a rarity, and promoted better aeration for the tree roots than may have existed in other parts of the bays. This micro-site phenomenon has undoubtedly been observed many times on both drained and natural sites. Whether it be on an old stump, ditch bank, man-made beds, or a slight rise, elevated trees often grow at a better rate than those only a few inches lower. This would suggest that land-owners should take advantage of any elevated spot when planting pine on wet forest land. An alternative would be to drain any low spots artificially to bring them to a drainage state comparable to the slightly elevated locations.

The growth differences due to soil are one of the striking results of this study. Previous research has shown that at approximately the same moisture level a higher rate of growth can be expected for loblolly pine on a heavy vs. a light soil. This is certainly supported by these measurements. Often in the past, woodland owners have put primary reliance on water table manipulation for increasing forest production without considering the soil to be drained. Innate fertility of soils should be evaluated before an area is drained because some peat and sandy soils are much less productive at any level of moisture without supplemental fertilization. At a minimum, a competent soil-site technician should be consulted in the planning stage of woodland drainage projects.

The fact that the trees grew better during wet rather than dry periods would suggest that loblolly pine can develop better on wet sites. But how wet? Some plant-soil-water relation studies indicate that loblolly pine grows better on deep, permeable, poorly drained soils with a fluctuating water table than on well-drained soils. Investigators also point out the remarkable ability of loblolly pine to withstand flooding if the water table fluctuates and does not remain above the surface too long. Seemingly in contrast, it has been shown that too high a water table can hinder pine growth and that drainage can greatly improve growth of residual trees. These results do not necessarily conflict, and in summary it appears that for loblolly pine to make good growth in the presence of a high water table, the root zone must be aerated frequently to some yet undefined depth.

We have seen an example of loblolly pine response to high average water table levels that do not completely inundate the root zone. It even appears—for the plots studied—that average growing season water table levels of -0.6 and -0.8 foot appear to be more beneficial to the trees than those averaging one to two feet lower. However, the water tables were continuously fluctuating to depths down to two feet, and it is unlikely the same results would have occurred if constant water table levels had been maintained. Because of the limited number of sampling locations and the short period of time covered by the study, we cannot definitely recommend these levels or any average water level or system of fluctuation as the most suitable for growth of loblolly pine. Nevertheless, the land-owner should be aware of loblolly pine's affinity for water when advising the drainage engineer of conditions desired in his woodlands.

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Table 1.--Summary of measurements collected on two drained wetland forest plots

Plot and season	Height growth	Diameter growth	Average Water table levels[1]	Minimum water table levels[1]	Maximum water table levels[1]	Rainfall	Average rainfall[2]
	Feet	Inches	Feet	Feet	Feet	Inches	Inches
Clay loam plot							
1963 growing season	3.3	0.41	-2.6	-0.7	-4.8	21.3	31.6
1964 growing season	3.9	0.96	-0.6	+0.1	-2.4	55.3	35.6
Loamy sand plot							
1963 growing season	1.3	0.19	-1.8	-0.3	-3.0	25.1	31.6
1964 growing season	1.7	0.38	-0.8	+0.1	-2.0	50.1	35.6

[1]With reference to ground surface.

[2]From long-term weather records for period.