



## Comparing the Growth of Longleaf and Loblolly Pine on Two Soil Types in North Carolina

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Longleaf pine has long had the reputation as a slow growing species unable to compete with loblolly pine. Boyer addressed what he called an “inherent bias” toward longleaf in a paper titled *Longleaf Can Catch-up* (Boyer 1996) in which he documented longleaf growth rates to become equal and eventually surpass those of loblolly pine. According to Boyer longleaf height catches up to loblolly between 25 to 30 years old especially on medium to low quality sites. Studies show that only on the very best sites does loblolly maintain a growth advantage over longleaf (Scmidling 1987, Outcult 1993). Once height growth begins longleaf grows as quickly as loblolly on most sites, and better on some.

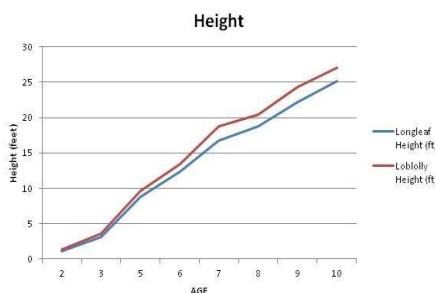
The NCFCS installed three demo sites to document longleaf growth rates after the grass stage, demonstrate its ability to catch-up to loblolly, and dispel the slow growth myth associated with longleaf pine forest management. Two are both high quality (94 SI base 50 loblolly) Raines soil site typically thought of as more suitable for loblolly plantation. It was planted in 1987, measured annually beginning at age 2, and last measured at age 10. The second site was also established in 1987, first measured at age 8, and last measured at age 17. The third is a lower quality site (80—85 SI base 50 loblolly) featuring Centenary and Lakeland sand soil type. This soil is often described as a typical longleaf site. It was established in 2000 and last measured at age 14. We abandoned both sites on the Raines soil after the first was adversely impacted by hurricane damage, and the second changed ownership and was harvested. We continue to measure the sand soil site.

### Results

#### Raines Soil #1

After 10 growing seasons, we measured the average height of the longleaf trees at 25.2 feet and loblolly trees at 27.0 feet. The diameter at age 10 was 4.0 inches for the longleaf and 4.5 inches for the loblolly.

Figure 1. Height from age 2 through age 10 measured on Raines #1.



The longleaf pine grew on average 2.52 feet per, while the loblolly pine grew at 2.70 feet per year. In this study we found that 88 % of the longleaf had initiated height growth after the first growing season. If we calculate a mean annual incre-

ment for the 9 years after height growth began, we find the longleaf trees grew on average 2.81 feet per year. Figure 1. shows loblolly height advantage from age 2 through age 10. At

Table 1. Site #1 diameters, heights, and periodic annual increment from age 2 through age 10 on a high quality Raines soil type.

Age	Longleaf				Loblolly			
	DBH (in.)	Longleaf HGHT (ft)	LL Height PAI	LL Height PAI (3 yr inter)	DBH (in.)	Loblolly Height (ft)	Lob Height PAI	Lob Hght PAI (3 yr inter)
2	na	1.1	0.6		na	1.4	0.7	
3	na	3.1	2	1	na	3.6	2.2	1.2
5	1.9	8.8	2.9		1.8	9.6	3	
6	2.7	12.4	3.6		2.2	13.4	3.8	
7	2.9	16.8	4.4	3.3	3	18.7	5.3	3.6
8	3.2	18.7	1.9		3.4	20.4	1.7	
9	3.6	22.2	3.5		4	24.3	3.9	
10	4	25.2	3	2.8	4.5	27	2.7	2.8

age 10 the height longleaf trees is 93 percent that of the loblolly trees.

#### Raines Soil #2

After 17 growing seasons the dominant and codominant longleaf and loblolly trees were on average 47.7 feet and 54.0 feet tall respectively. The measured trees averaged a DBH of 6.6 inches for longleaf and 8.3 inches for loblolly. As expected loblolly outgrew longleaf in height by 0.4 feet per year. The mean annual increment (MAI) for loblolly is 3.2 feet per year compared to 2.8 feet per year for longleaf. From age 9 through 17 the difference in annual height growth was only 0.2 feet per year. For those nine growing seasons the periodic annual incre-

Table 2. Site #2 : DBH, height, and periodic annual increments from age 8 - 17 for loblolly and longleaf on a Raines soil trees planted on a Raines soil

	Diameter (inches)						Height (feet)					
	Age 8	Age 11	Age 17	PAI Age 0 - 8	PAI Age 9 - 17	MAI Age 0 - 17	Age 8	Age 11	Age 17	PAI Age 0 - 8	PAI Age 9 - 17	MAI Age 0 - 17
Longleaf	3.12	4.55	6.55	0.39	0.38	0.39	18.34	27.20	47.70	2.29	3.26	2.81
Loblolly	4.36	5.61	8.25	0.55	0.43	0.49	22.70	32.10	54.00	2.84	3.48	3.18

ment (PAI) for longleaf was 3.3 feet compared to loblolly at 3.5 feet. Interestingly, if we assume the longleaf trees remained in the grass stage for one year and grew in height for 16 years, we find they grew at a PAI of 3.0 feet during that period. At age 17 the height of the longleaf trees is 88 percent the height of the loblolly trees. Diameter at breast height (DBH) showed the same trend with loblolly averaging 8.3 inch and longleaf averaging 6.6 inch at age 17. The diameter MAI at age 17 was 0.49 inches for loblolly and 0.39 inches for longleaf.

**Centenary/ Lakeland Sand Soil**

At age 14 the tree height averaged 24.6 feet on the longleaf plots and 34.3 feet on the loblolly plots. The average DBH was 4.1 inches for the longleaf trees and 5.0 inches for the loblolly trees. The average periodic annual increment for height since establishment was 2.5 feet per year for loblolly and 1.8 feet per year for longleaf. During that first 14 years loblolly grew on average 0.7 feet more a year than the longleaf. The difference in height PAI from 2004 to 2013 (after longleaf initiated height growth) was significantly less at 0.4 feet. During that 10 year period longleaf averaged 2.0 feet per year and loblolly averaged 2.4 feet per year. During the five year period from 2004 to 2009 loblolly averaged 2.4 feet per year while longleaf averaged 2.0 feet per year. The last five years (2009 –2013) the difference in annual height growth decreased to 0.3 feet as longleaf growth remained at 2.0 feet per year while the loblolly slowed to 2.3 feet per year. At age 14 the height of the longleaf trees is 72 percent the height of the loblolly. Diameter at age 14 averaged 5.0 inches for the loblolly plots and 4.1 inches for the longleaf plots. Diameter PAI for the five years from 2009 to 2013 averaged 0.18 inches for the longleaf and 0.26 inches for the loblolly.

Table 3. Height and annual growth data at age 14 for longleaf and loblolly trees on a Centenary/Lakeland sandy soil series.

	Age 4	Age 9	Age 14	Age 0-4	Age 5-9	Age 10 - 14	Age 0-14	Less GS (2year)
	Height	height	Height	Height PAI	Height PAI	Height PAI	Height MAI	Height MAI
Longleaf	4.1	14.6	24.6	1.0	2.1	2.0	1.8	2.1
Loblolly	10.0	22.8	34.3	2.5	2.6	2.3	2.5	na

**Discussion**

As was expected loblolly outperformed longleaf in height and diameter growth on all three sites. However longleaf performed better than anticipated on the high site index sites and poorer on the lower quality site. At age 14 the loblolly are almost 10 feet taller than the longleaf on this sandy soil. On the higher quality sandy loam the loblolly was less than 2 feet taller after 10 years on one site and just over 6 feet tall after 17 years on the second. At the time of the final or most recent measurement on the Raines soil sites longleaf height was only 7 percent and 12 percent less than loblolly but on the sandy soil they were 29 percent less. The summary we made in Table 4. depicts the growth rate advantage for the loblolly trees. While loblolly maintained an early growth, we see that longleaf remained competitive. It is interesting to note that the early growth for loblolly on the lower quality site although lower was comparable. On Raines site #1 we reported that 88% of the longleaf seedling initiated height growth after on growing season. This is likely the primary reason for the small

Table 4. Total height and Mean Annual Increment for height for the three sites through each study period.

	Height (feet)		Mean Annual Increment Height (feet)		
	Longleaf	Loblolly	Longleaf	Loblolly	Difference
Raines Site #1 (through 10 years)	25.2	27	2.5	2.7	0.2
Raines Site #2 (through 17 years )	47.7	54.0	2.8	3.2	0.4
Centenary/ Lakeland (through 14 years)	24.6	34.3	1.8	2.5	0.7

difference in mean annual increment measured here. Linear regression trends plotted for height on the three sites indicate that while both loblolly and longleaf are trending upward, the longleaf slope is steeper. This suggests that the longleaf growth rate will eventually exceed loblolly. That remains to be seen.

Diameter growth has similar trends on all three sites. Longleaf diameter was 88%, 79%, and 82% to that of loblolly on Raines #1, Raines #2 , and Centenary/Lakeland sites respectively. The smaller diameter advantage compared to the larger height advantage, loblolly shown on the sandy soils may be attributed to stocking density as the longleaf site. Due to differences in survival and planting density the current longleaf stocking is 250 TPA compared to 573 TPA for the loblolly.

Overall the most surprising thing that came from the data is how well the longleaf performed on the high quality sites.

**References**

Boyer, William D., 1996. Longleaf pine can catch up. In: Proceedings of the First Longleaf Alliance Conference. Urban University, AL, Longleaf Alliance Report No. 1.pp 28-29

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Table 5. The periodic annual increments for height at various age interval from the three sites

