# WHOLE CANOPY GAS EXCHANGE AMONG ELITE LOBLOLLY PINE FAMILES SUBJECTED TO DROUGHT STRESS

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Future climate change simulations predict that the southeastern United States will experience hydrologic patterns similar to that currently found in the Western Gulf Region, meaning, that planted elite loblolly families may be subject to drier, hotter summers (Ruosteenoja et al. 2003, Field et al. 2007). Currently, there is little research on how these fast-growing loblolly families will perform under severe, summertime drought conditions. The summer of 2010 was extremely dry in northern Louisiana. From March to October precipitation totals were 46.3 cm (54%) below the 30 year average making this one of the driest summers on record (NOAA 2010). The objectives of this study were to determine how severe drought stress effected total tree leaf area, specific light saturated photosynthesis ($A_{Sat}$), and canopy level light saturated photosynthesis ($A_{Can}$) among four fast-growing loblolly families.

Four seed sources of loblolly pine (Pinus taeda L.) were planted in 0.15-acre plots at the LSU AgCenter Hill Farm Research Station in northwest Louisiana in January 2005. Each seed source was replicated 12 times in a randomized complete block design. All seed sources were from the eastern portion of the loblolly pine range. Two of the seed sources were of open-pollinated half-sib families (7-56 and 8-103), and two seed sources were clones (CL93 and CL9).

Gas exchange measurements were taken monthly from May to September 2010 using an open-flow, infrared gas analyzer equipped with 2 x 3 cm cuvette with a blue–red LED light source (Li-Cor 6400, Lincoln, Nebraska). Specific light saturated photosynthesis ($A_{Sat}$) measurements were taken on excised needles from the upper half of the tree. Measurements were made on previous year's latest fully elongated needles "OLD", and current year's first flush of needles "NEW". For this experiment these values were averaged into a single value. Total leaf area was estimated from allometric equations developed from destructive harvest of 24 trees harvested in September 2009. Allometric equations between height, diameter, and leaf biomass were created. Specific leaf area was used to convert total leaf biomass to total leaf area. These values were used to scale $A_{Sat}$ rates to the canopy level C assimilation ($A_{Can}$).

Specific $A_{Sat}$ did not differ among families, except for on the September sampling date when conditions were at their driest (Figure 1). Leaf area was consistently different among the families with 7-56>CL9>8-103>CL93. Clone 93 maintained the lowest canopy level $A_{Can}$ rates throughout the summer (Figure 1). This resulted in CL 93 accumulating comparatively less stem volume than the other three families. The percent change in stem volume is 21.7, 18.8, 17.7, and 7.2 percent, respectively for families 7-56, CL9, 8-103, CL93.

Severe drought stress did not significantly affect total tree leaf area; however, there was a significant reduction in both $A_{Sat}$ and $A_{Can}$ throughout the measurement period. The performance of high value families diminished with increasing drought stress. This is most apparent in $A_{Can}$ and stem volume comparisons, where CL93 yielded the greatest negative response. Considerations should be made when weighing the cost of establishing high value seedlings, particularly if summer droughts are predicted to become increasingly more common.

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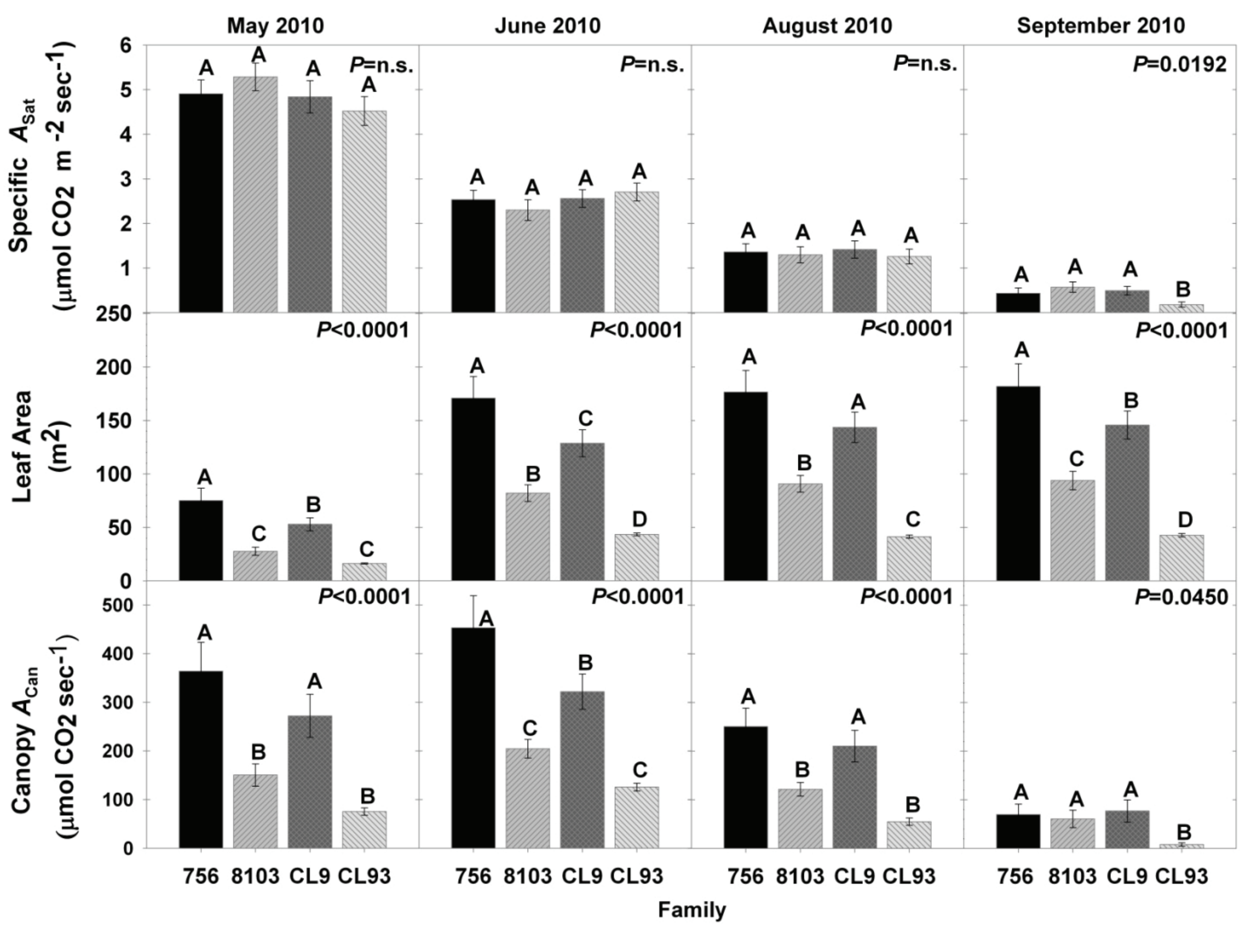


Figure 1—Mean specific light saturated photosynthesis ($A_{Sat}$; Top Panel), total leaf area (Middle Panel), and Canopy level photosynthesis ($A_{Can}$; Bottom Panel) for each Pinus taeda family measured on four separate sampling dates. Letters represent Fisher's LSD mean separation procedure ($P<0.05$; n=12). P-values were determined for each sampling date using ANOVA.