NATURAL PRUNING VARYING WITH SWEETGUM VARIETY AND DENSITY

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EXTENDED ABSTRACT

A sweetgum (*Liquidambar spp.)* study was installed at two sites in Louisiana in the winter of 2015-2016. Two taxa were planted including the native sweetgum, *L. styraciflua,* and a hybrid, *L. styraciflua x formosana,* in 25-tree block plots and have been measured for diameter and height each year. Crown closure appeared to begin during the mid-fourth year in blocks with near complete survival. By mid-growing season, some blocks of the faster growing hybrids began to both exhibit complete crown closure and begin the natural pruning process. We will explore the genetic and stocking effects on natural pruning. Overall, hybrids grew faster and had greater stocking than the native counterparts. The varying densities presented by the suite of hardwood genotypes presents a novel look at densities needed to stimulate limb fall.

Hardwood trees are economically and ecologically important to many States in the United States of America, especially in the eastern half of the country. The Eastern United States is home to approximately 90 percent of the Nation's hardwood growing stock (Smith and others 2001). Hardwood timber production is a large industry in Louisiana. In 2002, 131 million cubic feet of hardwood trees were harvested in Louisiana and 43 percent of trees harvested in Louisiana were pulpwood or other industrial products like composite panels and mulch (Bentley and others 2002). Of these hardwoods, sweetgum (*Liquidambar styraciflua*) is one of the most prolific hardwood species in regard to site adaptability and growth. Sweetgum is commonly found on upland sites alongside pine in full sunlight but grows fastest on bottomland sites (Koch 1985).

Recently, efforts to hybridize *L. styraciflua* with another species in the genus, in this case Formosan Gum (*L. formosana*), have been undertaken to further increase its productivity. Hybrid sweetgum varieties may be able to produce more biomass than native sweetgums efficiently on upland, drier sites allowing harvests year-round. These new genotypes could open up a new sphere of possibilities for land managers and timber companies (Martin 2016). If hybrid sweetgum varieties are adaptable to diverse soil and water conditions, they may be able produce rapid, high quality growth patterns that would also make them amenable to forest products such as veneer lumber that necessitates a premium on quality, mainly lack of knots. Thus, this study quantifies effects on natural pruning from verities of sweetgum and hybrid sweetgum.

Sweetgum verities were grown at two sites in north Louisiana including Louisiana Tech South Campus in Ruston, LA and Louisiana State University Agricultural Center's Hill Farm Research Station in Homer, LA. The Louisiana Tech study site was largely on an Angie fine sandy loam soil, with a small portion on a Sacul very fine sandy loam, while the Hill Farm site was located on a Darley-Sacul complex, with Darley being on the ridgetop and down the hillside and Sacul being predominant in the bottom below the hill. The limiting

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Citation for proceedings: Willis, John L.; Self, Andrew B.; Siegert, Courtney M., eds. 2022. Proceedings of the 21st Biennial Southern Silvicultural Research Conference. Gen. Tech. Rep. SRS-268. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 262 p. https://doi.org/10.2737/SRS-GTR-268.

factor at both sites was the presence of a hardpan; thus, both sites were subsoiled (ripped) to a 24-inch (0.6 m) depth in late summer prior to planting. One week before planting, 3 quarts per acre (7 L/ha) of glyphosate was applied (Accord XRTII® [Dow; Indianapolis, IN]) via ATV-mounted sprayer to remove any herbaceous vegetation present. Six Arborgen© sweetgum stocks were planted including two *Liquidambar styraciflua* half-sibling families and four sweetgum hybrid clones (*L. styraciflua x formosana).* All stock were planted as containerized 1-0 seedlings which were planted 8 feet apart along the row, while rows were 10 feet apart. Planting was conducted by hand with dibble bars on the upslope side of the rip. Planting was initiated and completed in early winter of 2015. The study was designed to have nine internal trees (3 tree x 3 tree) within each 5-tree x 5-tree plot.

Each year following the growing season, trees were measured for diameter at breast height (DBH) (when attaining 4.5 feet) and total height. In August and September of the 4th growing season, crown height (i.e., height to the lowest live branch) was measured as indicated by presence of leaves on the branch. Crown ratio was calculated from these measurements as the ratio of length of the live crown to total height of the tree. Though data were collected from all trees, analysis was done only on the internal trees from each plot. Pearson correlations were used to assess correlations among variables at the tree and plot level. Data were analyzed using the SAS Proc Glimmix. Fixed effects, site and planting stock, and random effect block were tested for effect on response variables crown height, crown ratio, total height, and DBH.

After four growing seasons, the total study height was 15.97 feet with an average DBH of 2.2 inches. Natural pruning was beginning to be evident for the internal trees and live limbs were not present below 3.99 feet above the ground. The average basal area of a plot was 32.2 square feet. At the tree level across the study, crown height was correlated with DBH and height at 0.43 and 0.62, respectively. As expected, crown ratio was negatively correlated with both traits with -0.24 and -0.43 for DBH and height, respectively. At the plot level, correlations of crown height with basal area per acre, stand density index, and trees per acre were 0.59, 0.58, and 0.22, respectively. Based on correlation strength with basal area per acre, this variable was included as a covariant in the Glimmix analysis and was found to significantly interact with the family effect to affect crown height ($p<0.001$). Family also significantly affected ($p<0.01$) DBH and height.

Interaction effect estimates on crown height differed among the families and was expressed by families having varying slopes across varying basal areas (fig. 1A). The two native sweetgum families (AGH25 and AGH2) both had negative though non-significant slopes, while AGHS2 and AGHS1 both had significantly greater slopes. These two hybrid families were also in the top three families for DBH growth (fig. 1B) and were the top two tallest average families (fig. 1C).

Hybrid sweetgum families outperformed native sweetgum families at two sites in Louisiana after four years of growth. Careful selection within the taxa may be needed for future production of high-quality lumber. While all four hybrids were superior to the native families, two taxa greatly outperformed the others in regard to self-pruning and demonstrated that they were affected by stand level basal area greatly. On the other hand, two hybrids as well as the two native families did not express a significant interaction with stand level basal area to effect self-pruning. These effects did not totally agree or differentiate with the single-tree growth patterns. This study demonstrates genetic differences among families contribute to the natural pruning promoting future high-quality lumber.

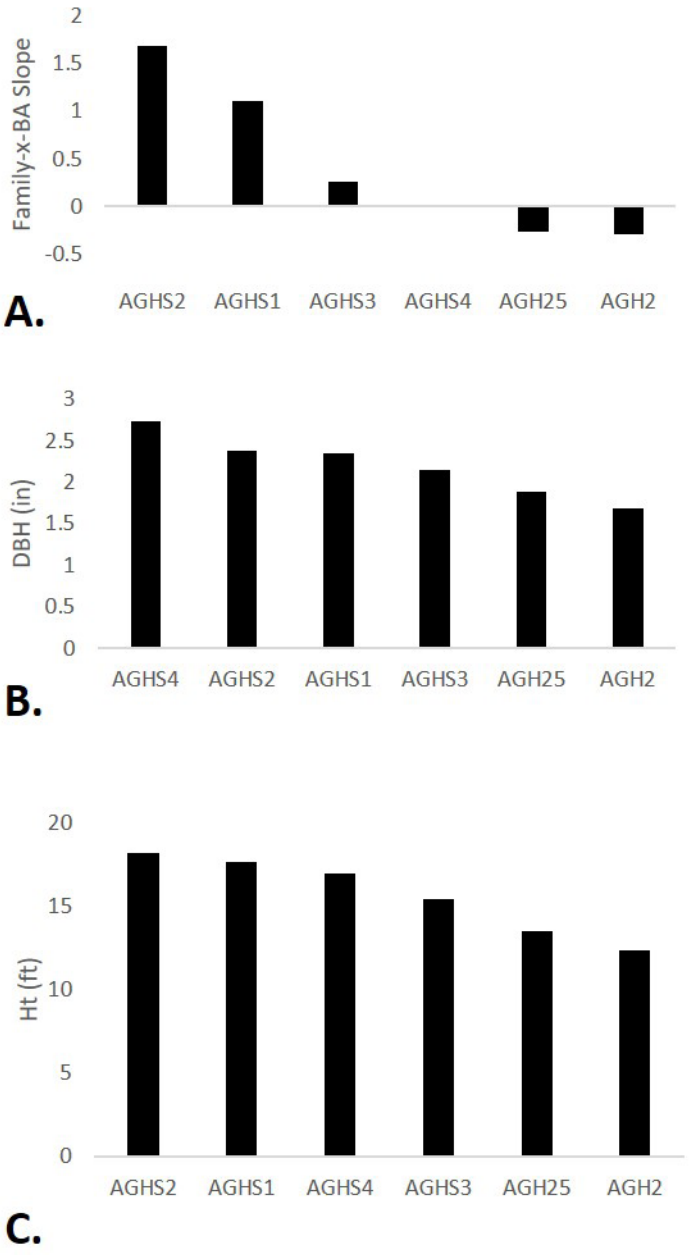

Figure 1—End of the year-5 growing season produced (A) slope estimates of basal area interacting with family to effect year-5 crown height (Ht), and the previous year growth as expressed by (B) average DBH (inches) across family and (C) average Ht (feet) across family.

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