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Fertilizer Response Curves for Commercial Southern Forest Species Defined with an Un-Replicated Experimental Design.

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There has been recent interest in use of non-replicated regression experimental designs in forestry, as the need for replication in experimental design is burdensome on limited research budgets. We wanted to determine the interacting effects of soil moisture and nutrient availability on the production of various southeastern forest trees (two clones of *Populus deltoides*, open pollinated *Platanus occidentalis, Liquidambar styraciflua* and *Pinus taeda*). Additionally, we required an understanding of the fertilizer response curve. To accomplish both objectives we developed a composite design that includes a core ANOVA approach to consider treatment interactions, with the addition of non-replicated regression plots receiving a range of fertilizer levels for the primary irrigation treatment. Half-acre treatment plots (1333 trees ha^{-1}) were established with treatments applied through drip-irrigation. The core ANOVA experiment demonstrated that each species responded to fertilizer, but the response to irrigation was variable. Clear irrigation response occurred in sycamore, sweetgum and one of the cottonwood clones. No irrigation response occurred for loblolly pine and the other cottonwood. Regression plots showed a strong fertilizer response below 170 kg N ha^{-1} yr^{-1}, beyond which little response was observed, but the point of no further response varied among species. The cottonwood and sycamore growth response leveled off beyond 150 kg N ha^{-1} yr^{-1} while sweetgum leveled off below 120 kg N ha^{-1} y^{-1}. A limited pine response to regression treatments contrasted with the consistent response found in ANOVA plots. Regression is an economical approach to define treatment responses in plot-scale experiments and can be used to construct models describing the relationship between variables; however a sufficient number of treatments is still required so that the response of any single plot does not pull the line with uneven power.