IMPACTS OF INTENSIVE MANAGEMENT AND GENETIC IMPROVEMENT ON SOIL CO_2 EFFLUX AND CARBON CYCLING IN MANAGED LOBLOLLY PINE FORESTS

Chelsea G. Drum, Eric J. Jokela, Jason G. Vogel, Edward A. G. Schuur, and Salvador Gezan[1]

In the southeastern United States, fertilization and weed control treatments, with deployment of genetically improved seedlings planting stock, are routinely used to increase aboveground productivity (Jokela and others 2004). The sustainability of forest productivity under these silvicultural regimes relies, to a certain extent, on the rate of the microbial conversion of plant litter to soil organic matter (SOM) and SOM to carbon dioxide (CO_2). In managed loblolly pine (*Pinus taeda* L.) forests, nearly 50 percent of the carbon (C) is found in the soil to a depth of 1 m, and previous research has indicated that this C can increase with fertilization (Vogel and others 2011). However, in managed forests, SOM dynamics are still unclear (Jandl and others 2007). While we would anticipate an increase in SOM with increasing aboveground productivity, alterations in plant C allocation, understory C inputs, and microbial response to fertilization could lead to unpredicted results (Vogel and others 2011).

This project examined the effects of intensive management and genetic selection of loblolly pine on soil CO_2 efflux and C cycling. In Florida, two field installations at Gainesville, FL (Site A) and Sanderson, FL (Site B) of two families of loblolly pine, one “fast” and one “slow” grower, were studied in a replicated, family block design with two levels of nitrogen and phosphorus fertilization, high and low culture (table 1). Measurements of root biomass and repeated measurements of forest growth, soil CO_2 efflux, and litterfall were used to determine C allocation patterns. Soil CO_2 efflux and litterfall measurements were used to estimate Total Belowground Carbon Flux (TBCF), an estimate of C allocation to roots.

Table 1--Cumulative element nutrient application rates for the high- and low-culture treatments at two sites in north Florida through 2008

Location	Culture	Nitrogen	Phosphorous
		------*pounds per acre*----	
Site A	High	400	90
	Low	45	54
Site B	High	680	160
	Low	196	70

The high culture treatment and family had a significant ($p < 0.01$) effect on loblolly pine mean aboveground biomass increment at both sites, with the fertilization effect being nearly 2 times greater than the family effect (fig. 1). The high culture significantly ($p < 0.05$) decreased soil CO_2 efflux, fine root biomass, and TBCF in three of the four families studied. Litterfall was significantly increased by greater fertilization, and the family effect was significant. The family x fertilization effect for TBCF was significant at Site B, indicating that one family did not significantly decrease TBCF in response to the heavier fertilization treatment. Results from these studies suggest that, with increasing levels of fertilization, belowground allocation and likely C inputs to the soil were reduced.

[1]Graduate Student and Professor, respectively, University of Florida, School of Forest Resources and Conservation, Gainesville, FL 32611; Assistant Professor, Texas A&M University, Department of Ecosystem Science and Management, College Station, TX 77843; Associate Professor, University of Florida, Department of Biology, Gainesville, FL 32611; and Assistant Professor, University of Florida, School of Forest Resources and Conservation, Gainesville, FL 32611.

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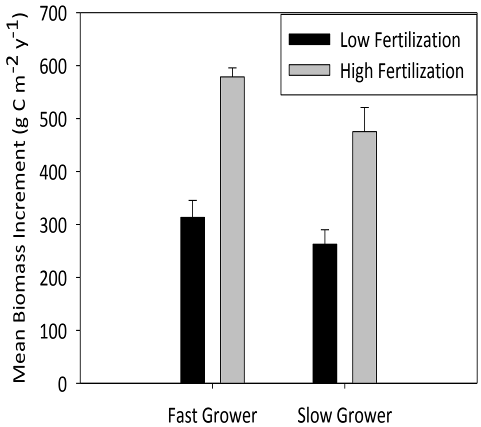

Figure 1--Aboveground mean biomass increment (MBI; g C $m^{-2}year^{-1}$) at Site A. High fertilization and family had a significant ($p < 0.01$) effect on MBI, with the fertilization effect nearly two times greater than the family effect.

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