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ORIGINAL PAPER

Short-term changes in biomass partitioning of two full-sib clones of *Pinus taeda* L. under differing fertilizer regimes over 4 months

Jeremy P. Stovall · Thomas R. Fox · John R. Seiler

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Abstract Clonal forestry is a reality in the southeastern United States due to improvements in somatic embryogenesis of *Pinus taeda* L. Differences in below-ground carbon (C) allocation between individual genotypes could alter C sequestration and cycling in these clonal plantations. Biomass partitioning may vary between clones and in response to management practices, like fertilization. Our objective was to quantify differences in biomass partitioning due to fertilization in contrasting clones of *P. taeda* produced from the same full-sib cross. A two (clone)-by-two (fertilizer)-by-four (sequential harvest) factorial randomized complete block design was replicated eight times in a greenhouse for 4 months. Trees were destructively harvested monthly following fertilizer application, so changes in biomass partitioning could be determined. Both clones responded to fertilizer with a short-term reduction in root:shoot ratio and increase in foliar biomass. These changes were ephemeral, returning to control levels within 4 months. Fertilizer responses in below-ground partitioning were due to allometric differences in one clone, but were only attributable to altered rates of development in the other. Ephemeral changes in biomass partitioning in response to fertilizer application were consistent with a theory of short-term physiological response to increased nutrient availability fueling long-term fertilizer growth responses.

Keywords Allometry · Carbon allocation · Intensive silviculture · Varietal forestry

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J. P. Stovall · T. R. Fox · J. R. Seiler
Department of Forest Resources and Environmental Conservation, Virginia Tech, 228 Cheatham Hall (0324), Blacksburg, VA 24061, USA

Present Address:
J. P. Stovall (✉)
419 East College St., SFA Station, Box 6109, Nacogdoches, TX 75692, USA
e-mail: stovalljp@sfasu.edu

Introduction

Clonal plantations are now becoming common in the southeastern USA as improvements in somatic embryogenesis make possible the mass production of *Pinus taeda* (L.) clones (Stelzer and Goldfarb 1997; Whetten and Kellison 2010). Fertilizer application is also a common practice in plantations, with average growth increases across the southeast of ∼25% due to mid-rotation additions of nitrogen (N) and phosphorus (P) (Fox et al. 2007b). In order to maximize growth potential in clonal plantations to justify more expensive genetic material at planting, fertilization and other intensive silvicultural practices will need to be applied (Dougherty 2007). However, differences in morphology and development among clones may require different silvicultural prescriptions for different clones (Roth et al. 2007; Tyree et al. 2009b).

A two-phase model of single application fertilizer-induced growth response was posited by Gough and Seiler (2004) and Gough et al. (2004). The first phase describes the physiological mechanisms by which plants respond in the short-term to fertilizer application. Immediately following fertilizer application, root respiration increases to accommodate increased nutrient uptake. Nutrients, particularly N, are allocated to leaves, increasing photosynthetic rates and increasing the rate of photosynthate accumulation. This additional photosynthate is then allocated to the