Linking above-ground biomass production to below-ground carbon fluxes across stocking, clone, fertilization, and understory elimination in Pinus radiata D.Don plantations, New Zealand

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Abstract

The linkage between above-ground biomass production and below-ground carbon fluxes as influenced by silviculture has been insufficiently studied. We tested the effects of stocking, clone, fertilization, and follow-up herbicide treatments on below-ground carbon flux (BCF), above-ground biomass production (AGB), the ratio (BCF/AGB), tree diameter (DBH), height (H), basal area (G), and leaf area index (LAI) for a Pinus radiata D. Don plantation trial in the Canterbury region of New Zealand. Mixed-effects analysis of variance was carried out using data at the plot and clone levels.

The H, DBH, G, AGB, BCF and the BCF/AGB ratio were influenced significantly by the main effects of stocking ($p < .05$), and the follow-up herbicide ($p < .001$). The main effects of clone had significant influence on H ($p < .001$), BCF ($p < .01$) and the BCF/AGB ratio ($p < .01$). Values of AGB and G increased with stand density, while DBH and H decreased with stand density. The significant stocking x follow-up herbicide interactions observed for DBH, G and AGB, suggested that follow-up weed control alleviated understory-induced water and nutrient stresses. Significant clone x follow-up herbicide interactions for DBH and AGB ($p < .05$), and clone x stocking interactions for G ($p < .05$), and no interaction of silvicultural treatments for BCF and BCF/AGB ratio were observed. Clones 1 and 3 exhibited greater AGB and smaller BCF/AGB ratio, compared to slower growing clones (i.e., Clones 4 and 5), suggesting certain clones were more productive above-ground at the expense of less carbon partitioned below-ground. These findings highlight that stocking, follow-up herbicide, and clone, in that order, had the greatest influence on above- and below-ground variables, suggesting that those silvicultural practices shifted carbon partitioning above-and below-ground. We conclude that well-performing clone planted with appropriate stand density and with follow-up weed control treatments may increase aboveground radiata pine productivity.

Palabras clave

Palabras clave de autor: Above-ground; Below-ground; Carbon; Fertilization; Genotype; Partitioning; Stand density
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