Fine-root mass, growth and nitrogen content for six tropical tree species

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Abstract Although fine roots might account for 50% of the annual net primary productivity in moist tropical forests, there are relatively few studies of fine-root dynamics in this biome. We examined fine-root distributions, mass, growth and tissue N and C concentrations for six tree species established in 16-year-old plantations in the Caribbean lowlands of Costa Rica in a randomized-block design ($n=4$). The study included five native species (*Hyeronima alchorneoides*, *Pentaclethra maculosa*, *Virola koschnyi*, *Vochysia ferruginea* and *Vochysia guatemalensis*) and

one exotic (*Pinus patula*). Under all species >60% of the total fine-root mass to one meter deep was located in the uppermost 15 cm of the soil. Fine-root live biomass and necromass (i.e., the mass of dead fine roots) varied significantly among species but only within the uppermost 15 cm, with biomass values ranging from 182 gm^{-2} in *Pinus* to 433 gm^{-2} in *Hyeronima* plots, and necromass ranging from 48 gm^{-2} in *Pinus* to 183 gm^{-2} in *Virola* plots. Root growth, measured using ingrowth cores, differed significantly among species, ranging from 261 $\text{gm}^{-2} \text{yr}^{-1}$ in *Pinus* to 891 $\text{gm}^{-2} \text{yr}^{-1}$ in *Hyeronima*. Turnover rates of fine root biomass ranged from 1.09 to 2.03 yr^{-1} in *Virola* and *Hyeronima* plots respectively. Fine-root biomass was significantly and positively correlated with fine-root growth ($r=0.79$, $P<0.0001$), but did not correlate with fine-root turnover ($r=0.10$; $P=0.20$), suggesting that fine-root accumulation is a function of growth rate rather than mortality. Fine-root longevity was not correlated ($r=0.20$, $P=0.34$) and growth was negatively correlated with root N concentration across species ($r=-0.78$, $P<0.0001$), contrary to reported trends for leaves, perhaps because N was relatively abundant at this site.

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Table 4 Annual fine-root ingrowth and turnover rates for six tropical species in 16-yr-old single-species plantations in lowland Costa Rica

Species	Ingrowth rate (g m ⁻² yr ⁻¹)	Turnover rate (yr ⁻¹)	
		Biomass	Carbon
<i>Hyeronima alchorneoides</i>	891 (109) ^A	2.03 (0.10) ^A	2.00 (0.13) ^A
<i>Pentaclethra macroloba</i>	438 (50) ^{BC}	1.45 (0.17) ^{AB}	1.45 (0.17) ^{AB}
<i>Pinus patula</i>	261 (30) ^C	1.51 (0.28) ^{AB}	1.51 (0.28) ^{AB}
<i>Virola koschnyi</i>	419 (57) ^{BC}	1.09 (0.11) ^B	1.06 (0.10) ^B
<i>Vochysia ferruginea</i>	354 (12) ^C	1.46 (0.12) ^{AB}	1.49 (0.13) ^{AB}
<i>Vochysia guatemalensis</i>	730 (149) ^{AB}	1.81 (0.23) ^{AB}	1.93 (0.26) ^A

Values are means (standard error, n=4) for the uppermost 15 cm of soil only. Different letters indicate significant differences among species (Tukey-Kramer HSD test; $\alpha=0.05$)