

Supporting Information

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Table S1. Nitrogen stocks in biomass and detritus ($\text{kg}\cdot\text{ha}^{-1}$) in plantations of four experimental tree species in lowland Costa Rica

Component	Species				Mean
	<i>Hieronyma</i>	<i>Pentaclethra</i>	<i>Virola</i>	<i>Vochysia</i>	
Aboveground, nonwoody*					
Overstory	69 ± 6	123 ± 29	72 ± 14	64 ± 6	82 ± 27
Understory	31 ± 2	34 ± 11	50 ± 5	62 ± 16	44 ± 14
Branches [†]					
Overstory	121 ± 10 ^{AB}	207 ± 44 ^A	87 ± 19 ^B	148 ± 15 ^{AB}	141 ± 51
Understory	42 ± 9	42 ± 26	79 ± 17	99 ± 19	66 ± 28
Boles					
Overstory	206 ± 22	283 ± 93	290 ± 63	450 ± 43	307 ± 102
Understory	12 ± 1	16 ± 12	17 ± 4	19 ± 7	16 ± 3
Aboveground biomass					
Overstory	397 ± 38	613 ± 165	449 ± 95	661 ± 64	530 ± 127
Understory	86 ± 11	93 ± 48	145 ± 24	179 ± 38	126 ± 45
Total aboveground	482 ± 45	706 ± 138	594 ± 109	841 ± 64	656 ± 154
Belowground biomass N					
Fine roots, aboveground [‡]	12 ± 5	1 ± 0	1 ± 1	1 ± 1	4 ± 3
Fine roots, 0–15 cm	59 ± 1	64 ± 7	61 ± 6	64 ± 9	62 ± 1
Fine roots, 15–100 cm	36 ± 6	41 ± 9	35 ± 9	29 ± 3	35 ± 3
Medium roots	24 ± 1	37 ± 6	40 ± 11	33 ± 11	33 ± 7
Large roots, stumps	73 ± 12	121 ± 26	61 ± 13	99 ± 17	88 ± 27
Total belowground	192 ± 9	261 ± 29	196 ± 29	224 ± 34	218 ± 32
Total biomass N	674 ± 53	967 ± 152	790 ± 127	1,065 ± 81	874 ± 176
Detritus					
Surface litter [§]	101 ± 8 ^{AB}	79 ± 7 ^{AB}	59 ± 5 ^B	109 ± 15 ^A	87 ± 23
Coarse woody debris	16 ± 4	21 ± 5	9 ± 2	20 ± 2	16 ± 5
Dead roots, all sizes	25 ± 2 ^{BC}	47 ± 8 ^A	45 ± 2 ^{AB}	15 ± 2 ^C	33 ± 16
Total detritus	142 ± 4	147 ± 15	114 ± 8	144 ± 14	137 ± 15
Total biomass and detritus	816 ± 54	1,114 ± 158	903 ± 120	1,209 ± 94	1,011 ± 182

Means (\pm SEM) are based on $n = 4$. Tree species are *Hieronyma alchorneoides*, *Pentaclethra macroloba*, *Virola koschnyi*, and *Vochysia guatemalensis*. Means within a row followed by the same superscript letter do not differ significantly among species [Tukey's honestly significant difference (HSD), $P = 0.05$].

*Nonwoody includes leaves, flowers, and fruits, and is equivalent to canopy. Overstory (planted) trees are ≥ 10 cm in diameter at breast height; understory includes trees and saplings ≥ 2.5 cm in diameter and understory herbs and shrubs.

[†]Branches are ≤ 10 cm in diameter; boles are > 10 cm in diameter.

[‡]Fine roots are unsubsized and generally ≤ 2 mm, medium roots are > 0.2 – 1 cm, and large roots are > 1 cm in diameter and include stumps and stump roots, with all root categories measured to 1-m depth.

[§]"Surface litter" includes the O horizon of the soil; coarse woody debris does not include standing dead, which was negligible in these aggrading systems.

Table S2. Soil N stocks (kg·ha⁻¹) and C:N in plantations and reference sites in lowland Costa Rica

Soil property	Depth (cm)	Vegetation					Forest*
		<i>Hieronyma</i>	<i>Pentaclethra</i>	<i>Virola</i>	<i>Vochysia</i>	Pasture*	
Total N	0–15	3,564 ± 208 ^{BC}	3,424 ± 134 ^C	3,460 ± 23 ^C	3,909 ± 149 ^{AB}	3,645 ± 89 ^{BC}	4,200 ± 217 ^A
	15–30	3,264 ± 86 ^B	3,227 ± 195 ^B	2,974 ± 90 ^B	3,474 ± 113 ^{AB}	3,736 ± 85 ^A	3,826 ± 212 ^A
	30–50	2,685 ± 72 ^{BC}	2,152 ± 176 ^C	2,528 ± 172 ^{BC}	2,961 ± 111 ^{AB}	3,432 ± 426 ^A	2,942 ± 266 ^{AB}
	50–75	2,575 ± 136 ^{AB}	2,162 ± 279 ^B	2,697 ± 159 ^{AB}	2,981 ± 42 ^A	3,081 ± 349 ^A	2,750 ± 84 ^A
	75–100	2,410 ± 43 ^A	1,812 ± 262 ^B	2,516 ± 111 ^A	2,589 ± 40 ^A	2,504 ± 243 ^A	2,552 ± 54 ^A
	0–100	14,498 ± 481 ^{AB}	12,777 ± 915 ^B	14,175 ± 498 ^B	15,914 ± 146 ^A	16,365 ± 767 ^A	16,131 ± 669 ^A
C:N	0–100	12.37 ± 0.28 ^A	11.76 ± 0.44 ^{AB}	11.64 ± 0.24 ^{AB}	11.70 ± 0.14 ^{AB}	11.25 ± 0.05 ^B	11.01 ± 0.42 ^B

Means (±SEM) are based on $n = 4$ blocks in plantations, three or four replicates in other vegetation. Tree species are as in Table S1. Means within a row followed by the same superscript letter do not differ significantly among species (Tukey's HSD, $P = 0.05$).

*Pasture refers to abandoned pasture, and forest refers to mature forest; both sets of reference sites are situated within 500 m of experimental plots, on the same soil type.

Table S3. Nitrogen uptake (kg·ha⁻¹·y⁻¹) in plantations of four experimental tree species in lowland Costa Rica

Component	Species				Mean
	<i>Hieronyma</i>	<i>Pentaclethra</i>	<i>Virola</i>	<i>Vochysia</i>	
Fine litterfall	157 ± 11 ^B	199 ± 15 ^A	115 ± 8 ^C	155 ± 5 ^{BC}	157 ± 34
Branchfall	9 ± 2	22 ± 9	4 ± 1	12 ± 3	12 ± 4
Overstory N uptake*					
Nonwoody [†]	106 ± 9	147 ± 31	75 ± 8	108 ± 3	109 ± 30
Branches	15 ± 3	34 ± 11	9 ± 2	20 ± 3	20 ± 11
Bolewood	12 ± 2	27 ± 8	17 ± 4	24 ± 1	20 ± 7
Total overstory	133 ± 12	209 ± 48	101 ± 14	152 ± 3	149 ± 45
Understory N uptake					
Nonwoody	54 ± 7	59 ± 21	60 ± 4	57 ± 12	57 ± 3
Branches	19 ± 4	21 ± 4	21 ± 1	32 ± 2	23 ± 6
Bolewood	2 ± 1	3 ± 2	4 ± 1	3 ± 1	3 ± 1
Total understory	75 ± 10	83 ± 27	85 ± 4	92 ± 11	84 ± 7
ΔBiomass [‡]					
Canopy	5 ± 1	9 ± 1	8 ± 1	8 ± 1	8 ± 2
Woody tissues	30 ± 3	66 ± 10	42 ± 8	49 ± 2	47 ± 15
Total	35 ± 4 ^B	75 ± 11 ^A	51 ± 9 ^{AB}	57 ± 1 ^{AB}	54 ± 17
ΔBiomass, years 0–17	41 ± 4	60 ± 10	49 ± 8	67 ± 5	55 ± 11
Total aboveground	209 ± 14 ^{AB}	292 ± 33 ^A	186 ± 11 ^B	244 ± 8 ^{AB}	233 ± 46
Fine root ingrowth [§]	127 ± 9 ^A	94 ± 10 ^{AB}	75 ± 9 ^B	122 ± 22 ^{AB}	105 ± 24
Medium root growth	2 ± 0	3 ± 1	3 ± 1	2 ± 1	2 ± 1
Large root growth	4 ± 1 ^B	20 ± 8 ^A	1 ± 0 ^B	3 ± 1 ^B	7 ± 9
Total belowground	133 ± 9	117 ± 14	79 ± 9	127 ± 23	114 ± 24
Total N uptake	341 ± 11 ^{AB}	409 ± 35 ^A	265 ± 18 ^B	371 ± 21 ^A	347 ± 61

Means (±SEM) are based on $n = 4$. Tree species are as in Table S1. Means within a row followed by the same superscript letter do not differ significantly among species (Tukey's HSD, $P = 0.05$). Due to rounding, not all totals are consistent.

*N uptake values include ΔBiomass.

[†]Nonwoody (=canopy) includes leaves, flowers, and fruits. Branches are ≤10 cm in diameter; boles are >10 cm in diameter.

[‡]ΔBiomass was determined as the sum of growth increments of each tree within each plot; values reported are the means of years 15–17 and include nonwoody and woody tissues (branches, bolewood, and roots >2 mm). Long-term rates were determined by dividing total biomass N by age (16 y).

[§]Fine roots are unsubsized roots, generally ≤2 mm; medium roots are >0.2–1 cm; large roots are >1 cm in diameter and include stumps and stump roots. Fine-root ingrowth is for the 0–15 cm depth only; larger root growth extends to 1.0-m depth. Fine-root ΔBiomass was zero.

