

## Supplementary information

### Method S1: soil measurements

We collected 5 cm diameter soil cores up to 5 cm in depth, adjacent to every tree we sampled. We measured gravimetric water content (GWC) for each sample to express soil available P on a per unit soil dry mass basis. We measured orthophosphate available in the soils using resin strips and followed the method described in Cabugao *et al.* (2017). We incubated 5 g of root-free fresh soil subsamples with distilled H<sub>2</sub>O and resin strips for 24 hours on a shaker at the Sabana field station. We then removed the resin strips, rinsed them free of soil, and shipped them in plastic bags to ORNL for further analysis. We removed phosphate ions adsorbed on the resin strips by shaking resin strips in 50 ml of 0.25 M H<sub>2</sub>SO<sub>4</sub> for 1 hr and quantified the concentration using a Lachat QuikChem 8500 (Hach, Loveland, Colorado, USA, see Cabugao *et al.*, 2017).

We measured organic P in soil subsamples from each core as the sum of acid and alkali extractions (Bowman, 1989; Condron *et al.*, 1990; Cabugao *et al.*, 2021). We added 2 g of wet soil, 3 ml of 18 M H<sub>2</sub>SO<sub>4</sub>, and 4 ml of deionized water in a 50 ml falcon tube, vortexing constantly to mix the sample. We then added deionized water for a total solution volume of 48 ml and centrifuged the sample at 2500 rpm for 10 minutes. Using a Whatman No. 1 filter paper, we separated the supernatant and saved the filtered solution as the acid extract. Next, we cleaned the remaining soil by washing it with deionized water and centrifuging the slurry. We then added the filtered paper (from the acid extraction) to the soil and shook this mixture on a shaker with 98 ml of 0.5 M NaOH at room temperature for 2 hours. We obtained the alkali extract by centrifuging and filtering the sample. The acid and the alkali extracts were analyzed by a Lachat QuikChem 8500.

Table S1. P-value results from one-way ANOVA comparing root traits: root diameter (RD), root branching ratio (RBR), root branching intensity (RBI), mycorrhizal colonization percentage (AM col.), root phosphatase activity (PME), root phosphorus percentage (RP), specific root length (SRL), A) between sites for each species that are repeated in sites (only three species were found in more than one site), and B) between species within each site. \* Significant values.

<b>A. Root trait differences between sites for each species</b>							
<b>Species</b>	<b>RD</b>	<b>RBR</b>	<b>RBI</b>	<b>AM col.</b>	<b>PME</b>	<b>RP</b>	<b>SRL</b>
<i>Prestoea montana</i>	0.092	0.633	0.071	0.625	0.028*	0.404	0.627
<i>Cecropia scheberiana</i>	0.481	0.295	0.350	0.323	0.317	0.097	0.333
<i>Calophyllum calaba</i>	0.051	0.016*	0.221	0.097	0.276	0.115	0.632
<b>B. Root trait differences between species for each site</b>							
<b>Site</b>	<b>RD</b>	<b>RBR</b>	<b>RBI</b>	<b>AM col.</b>	<b>PME</b>	<b>RP</b>	<b>SRL</b>
EVS	<0.001*	0.007*	0.016*	0.002*	<0.001*	0.220	0.343
EV1	<0.001*	0.024*	0.250	0.004*	0.284	0.079	0.01*
SB2	0.310	0.043*	0.006*	0.001*	0.095	0.282	0.180

Table S2. Mixed effect models; dependent variables; fixed effects; random effects; P values from the slope parameters; marginal  $R^2$  ( $R^2_m$ ) and conditional  $R^2$  ( $R^2_c$ ); coefficient estimates. Models in bold are those used for figure 4 and S2.

Model (lmer)	Dependent variable	Fixed effects	Random effect	P value	$R^2_m/R^2_c$	Estimate
<b>Log(Root PME) ~ SRL + (1 Site)</b>	Log(Root PME)	SRL	(1 Site)	0.77	0.00/0.07	0.03
Log(Root PME) ~ SRL + (1   Site/Species)	Log(Root PME)	SRL	(1   Site/Species)	0.63	0.00/0.83	0.03
<b>Log(Root PME) ~ diameter + (1 Site)</b>	Log(Root PME)	Root diameter	(1 Site)	0.89	0.00/0.17	-0.27
Log(Root PME) ~ diameter + (1   Site/Species)	Log(Root PME)	Root diameter	(1   Site/Species)	0.68	0.00/0.76	-0.74
<b>Log(Root PME) ~ Mycorrhizal col + (1 Site)</b>	Log(Root PME)	Mycorrhizal colonization	(1 Site)	<0.01	0.43/0.60	0.03
Log(Root PME) ~ Mycorrhizal col + (1 Site/Species)	Log(Root PME)	Mycorrhizal colonization	(1   Site/Species)	0.18	0.08/0.75	0.01
<b>Log(Root PME) ~ Root branching ratio + (1 Site)</b>	Log(Root PME)	Root branching ratio	(1 Site)	0.02	0.17/0.28	-0.24
Log(Root PME) ~ Root branching ratio + (1 Site/Species)	Log(Root PME)	Root branching ratio	(1   Site/Species)	0.21	0.03/0.74	-0.11
<b>Log(Root PME) ~ Root branching intensity + (1 Site)</b>	Log(Root PME)	Root branching intensity	(1 Site)	0.63	0.00/0.15	-0.08
Log(Root PME) ~ Root branching intensity + (1 Site/Species)	Log(Root PME)	Root branching intensity	(1   Site/Species)	0.48	0.01/0.75	-0.09
<b>Mycorrhizal col ~ Root branching ratio + (1 Site)</b>	Mycorrhizal colonization	Root branching ratio	(1   Site)	0.04	0.25/0.32	-6.55
Mycorrhizal col ~ Root branching ratio + (1 Site/Species)	Mycorrhizal colonization	Root branching ratio	(1   Site/Species)	0.77	0.00/0.84	0.50

<b>Mycorrhizal col ~ Root branching intensity+(1 Site)</b>	Mycorrhizal colonization	Root branching intensity	(1   Site)	0.20	0.06/0.16	-4.60
Mycorrhizal col ~ Root branching intensity +(1 Site/Species)	Mycorrhizal colonization	Root branching intensity	(1   Site/Species)	0.16	0.03/0.83	-3.44
<b>Mycorrhizal col ~ SRL+(1 Site)</b>	Mycorrhizal colonization	SRL	(1   Site)	0.02	0.19/0.19	3.40
Mycorrhizal col ~ SRL +(1 Site/Species)	Mycorrhizal colonization	SRL	(1   Site/Species)	0.12	0.05/0.83	1.83
<b>Mycorrhizal col ~ diameter+(1 Site)</b>	Mycorrhizal colonization	Root diameter	(1   Site)	0.22	0.04/0.20	45.3
Mycorrhizal col ~ diameter +(1 Site/Species)	Mycorrhizal colonization	Root diameter	(1   Site/Species)	0.05	0.04/0.86	48.7
<b>Root P ~ log(Root PME) +(1 Site)</b>	Root P	Log(Root PME)	(1   Site)	0.35	0.03/0.21	<0.00
Root P ~ log(Root PME) +(1 Site/Species)	Root P	Log(Root PME)	(1   Site/Species)	0.35	0.03/0.21	<0.00
<b>Root P ~ Mycorrhizal col +(1 Site)</b>	Root P	Mycorrhizal colonization	(1   Site)	0.05	0.14/0.26	<0.00
Root P ~ Mycorrhizal col +(1 Site/Species)	Root P	Mycorrhizal colonization	(1   Site/Species)	0.05	0.14/0.26	<0.00
<b>Root P ~ Root branching ratio +(1 Site)</b>	Root P	Root branching ratio	(1   Site)	0.94	0.00/0.08	<-0.00
Root P ~ Root branching ratio +(1 Site/Species)	Root P	Root branching ratio	(1   Site/Species)	0.80	0.00/0.16	<0.00
<b>Root P ~ Root branching intensity +(1 Site)</b>	Root P	Root branching intensity	(1   Site)	0.05	0.12/0.20	<0.00
Root P ~ Root branching intensity +(1 Site/Species)	Root P	Root branching intensity	(1   Site/Species)	0.06	0.14/0.29	<0.00
<b>Root P ~ Soil P+(1 Site)</b>	Root P	Soil available P	(1   Site)	0.03	0.17/0.17	0.03
Root P ~ Soil P+(1 Site/Species)	Root P	Soil available P	(1   Site/Species)	0.02	0.18/0.17	0.03

Table 3. Mixed effects models; dependent variables; fixed effect; random effect (ID refers to the specific tree ID); P values; Emmeans are the estimated marginal means for time 1 (6 months before the hurricanes), and time 2 (6 months after the hurricanes).

<b>Model (lmer)</b>	<b>Dependent variable</b>	<b>Fixed effects</b>	<b>Random effect</b>	<b>P value</b>	<b>Emmeans time 1</b>	<b>Emmeans time 2</b>
Root PME ~ Time + (1 Site/Species/ID)	Root PME	Time	(1 Site/Species/ID)	<0.01	220.0	76.9
Root ratio ~ Time+ (1 Site/Species/ID)	Root branching ratio	Time	(1 Site/Species/ID)	0.38	3.43	3.99
Root intensity ~ Time+ (1 Site/Species/ID)	Root branching intensity	Time	(1 Site/Species/ID)	0.20	1.81	2.28
Root diameter ~ Time+ (1 Site/Species/ID)	Root diameter	Time	(1 Site/Species/ID)	0.24	0.37	0.32
SRL ~ Time+ (1 Site/Species/ID)	SRL	Time	(1 Site/Species/ID)	0.98	4.72	4.78
Root P ~ Time+ (1 Site/Species/ID)	Root P	Time	(1 Site/Species/ID)	0.21	0.15	0.13
Soil available P ~ Time+ (1 Site/Species/ID)	Soil available P	Time	(1 Site/Species/ID)	0.04	0.66	0.21

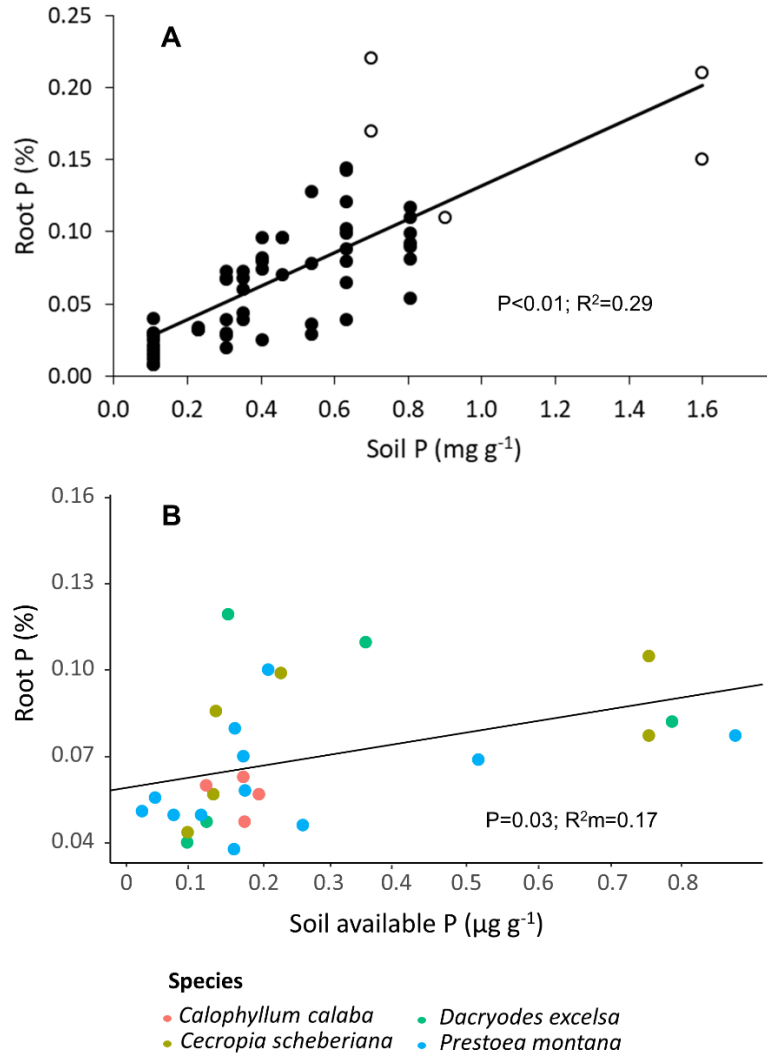


Figure S1. Relationship between phosphorus concentration in fine roots and: A) total P concentration in soil, where each point represents absorptive fine roots of a single species from two studies. Open symbols are temperate deciduous trees on three sites at the Laoshan Forest Research Station in northeastern China (Sun et al., 2016). Solid symbols represent 50 temperate rain forest species (ferns, woody and herbaceous angiosperms and conifers) at four sites along the Franz Josef soil chronosequence in New Zealand (Holdaway et al., 2011). The corresponding soil P values are the average of the 1 to 4 sites from which the roots were sampled (Richardson et al., 2004; Holdaway et al., 2011). Data were initially accessed through the Fine Root Ecology Database (FRED 3.0; Iversen et al., 2018). B) Soil available P using resin strips (see Methods S1). The regression line, P-value, and marginal  $R^2$  ( $R^2_m$ ) are from the mixed effect model, where site was the random effect.

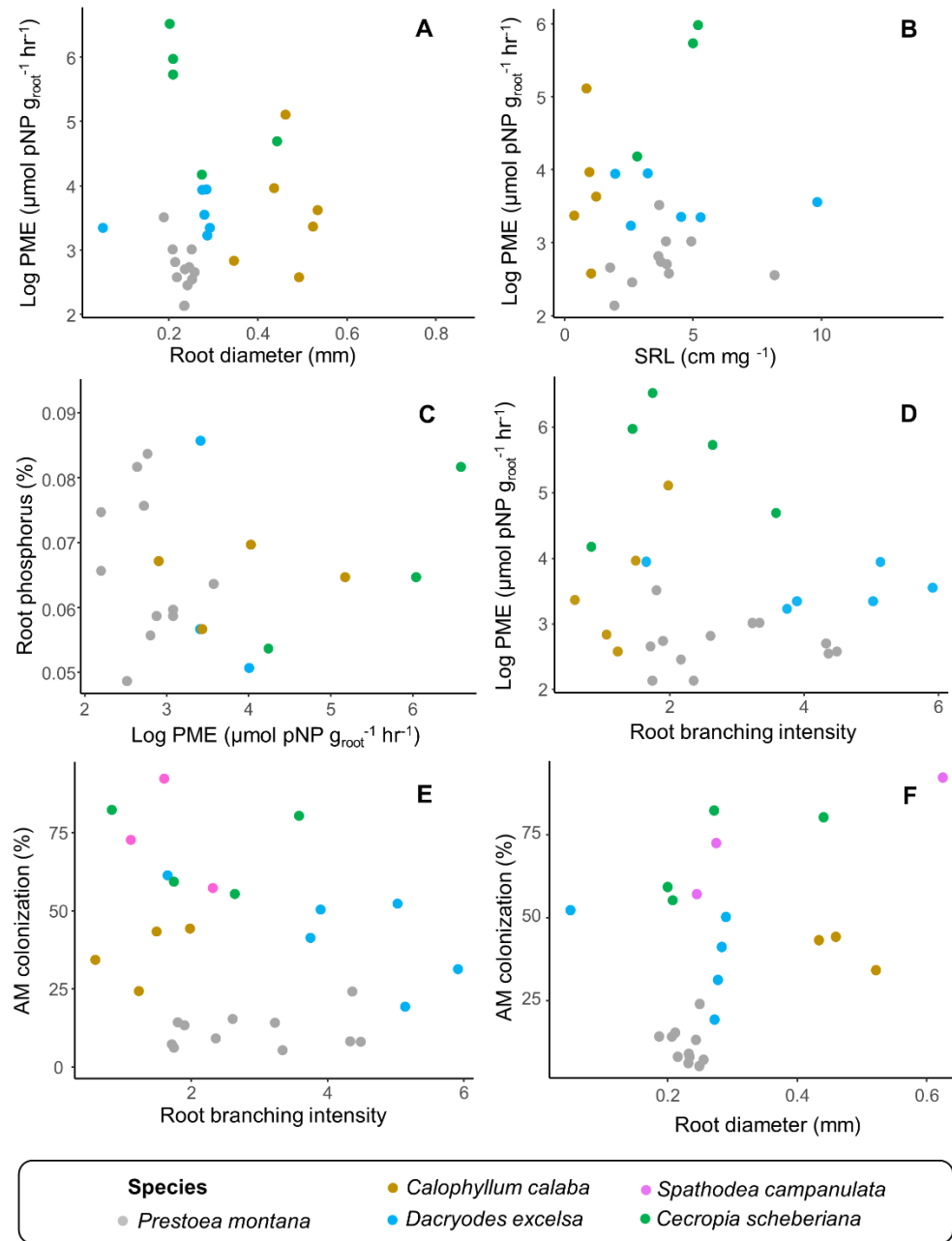


Figure S2. Non-significant bivariate relationships among the seven fine-root traits measured in this study. Linear mixed-effects models were fitted for each root trait combination to account for the hierarchical nature of our dataset (see Supplementary Table 2). The relationships include root phosphatase activity (phosphomonoesterase; PME) with (A) root diameter, with (B) root length (SRL), with (C) root phosphorus concentration (root P), and with (D) root branching intensity; and arbuscular mycorrhizal (AM) colonization with (E) root branching intensity, and with (F) root diameter. Data are shown after the hurricanes passed over the island in 2017. Due to sampling constraints, root PME activity was not measured for *Spathodea campanulata*.

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