2023 International Young Scientist Forum for Climate Change
Bamboo-based Solutions

Phylogeny, trade-offs and associations of functional traits in leaves and culms of 77 woody bamboo species

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Introduction

- Woody bamboo is an important component of the canopy and understory of terrestrial forest ecosystems, but studies on their functional traits are quite inadequate to match their ecological roles.
- **Questions**
  - ➢ To what extent does phylogeny and climate influence functional traits in woody bamboo?
  - ➢ Is there a leaf economics spectrum across woody bamboo species? If so, does it fit the global LES pattern?
  - ➢ Are functional traits of culm and leaf in woody bamboo correlated?

Materials and methods

- **Location**: International Bamboo Germplasm Resource Bank of Wangjiang Tower Park (Chengdu, China);
- **Species**: 77 woody bamboo species;
- **Traits**: leaf mass per area (LMA), nitrogen concentration (N), phosphorus concentration (P), maximum assimilation rate based on area (A_{area}) and mass (A_{mass}), dark respiration rate based on area (Rd_{area}) and mass (Rd_{mass}); ground diameter (GD), internode length (ITL).

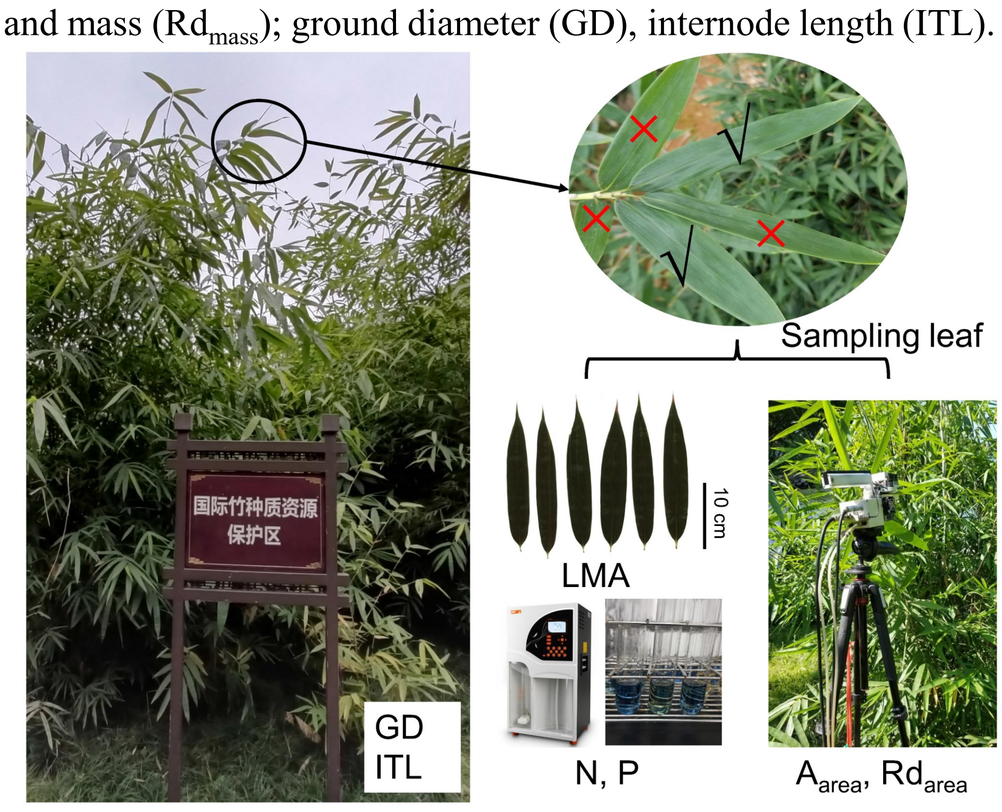


Figure 1 Study materials, sampling and measurement methods.

Results

- The coefficient variation of traits ranged from 20.96 – 86.83%;
- Phylogenetic signals were found in GD, ITL, P, A_{area}, and Rd_{area};
- Heritability and climate explained 52.12 – 87.95% of the total trait variations.

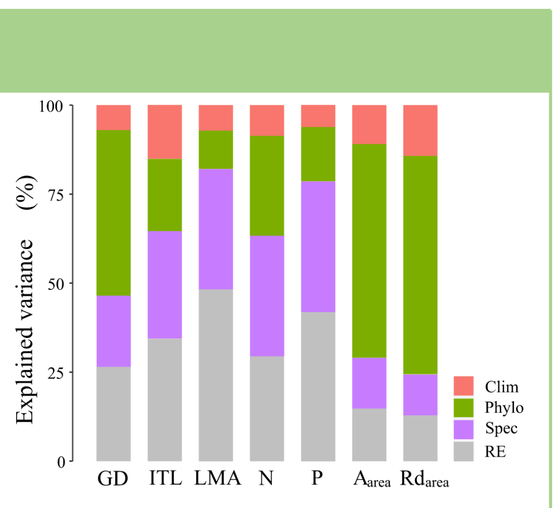


Figure 2 Variance decompositions of Bayesian phylogenetic multilevel models.

Table 1 Descriptive statistics and phylogenetic signals (Pagel's λ) of the functional traits across 77 woody bamboo species

Traits	Units	Mean	Range	CV (%)	Pagel's λ
GD	cm	3.81	0.20–16.00	86.83	0.619***
ITL	cm	28.55	5.00–56.00	40.44	0.788***
LMA	g m^{-2}	37.22	12.65–77.69	35.89	0.143
N	%	1.84	0.93–3.13	20.96	0.243
P	%	0.12	0.07–0.21	24.16	0.391*
A_{area}	μmol m^{-2} s^{-1}	10.95	3.43–22.28	41.99	0.751***
Rd_{area}	μmol m^{-2} s^{-1}	1.34	0.36–4.38	60.93	0.880***

CV: coefficient of variation (100 × standard deviation/mean). *$P < 0.05$ and ***$P < 0.001$.

- Leaf economic spectrum (LES) was found in woody bamboo taxa;
- Woody bamboo is a resource-acquisition taxon in global LES;
- The tradeoffs of LES between bamboo and non-bamboo groups showed differences.

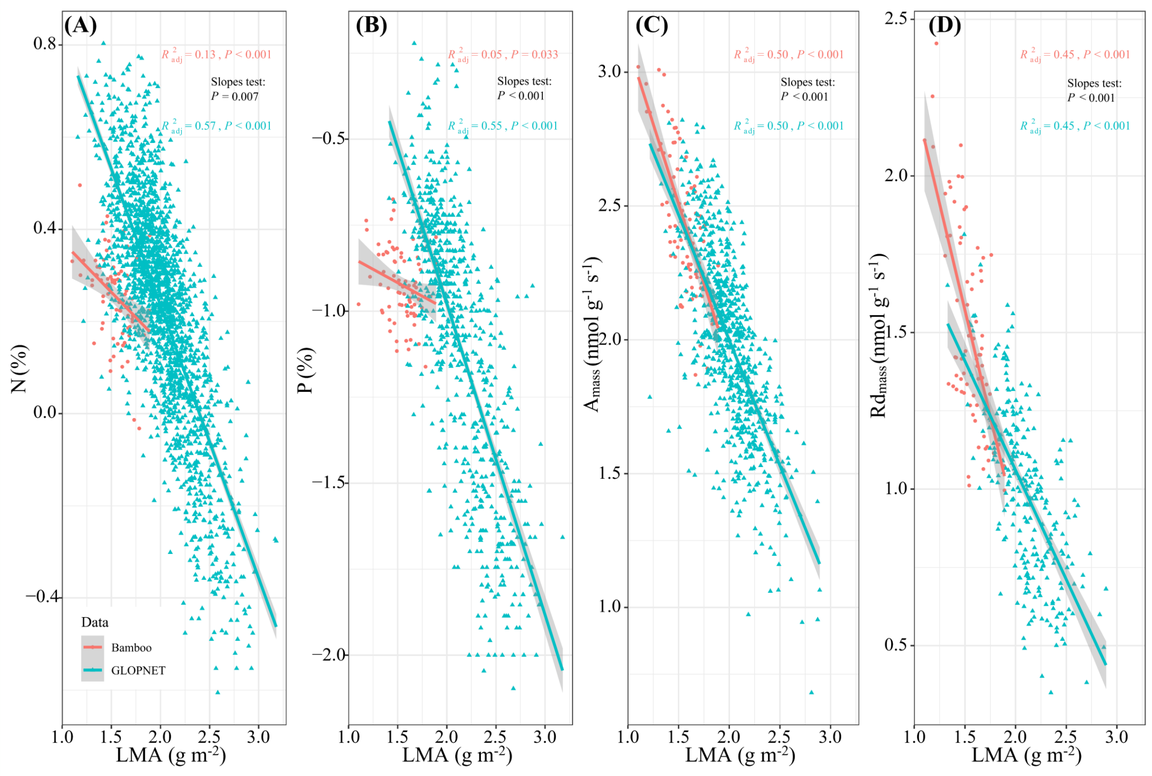


Figure 3 Bivariate trait relationships of leaf N, P, Amass, Rdmass with LMA.

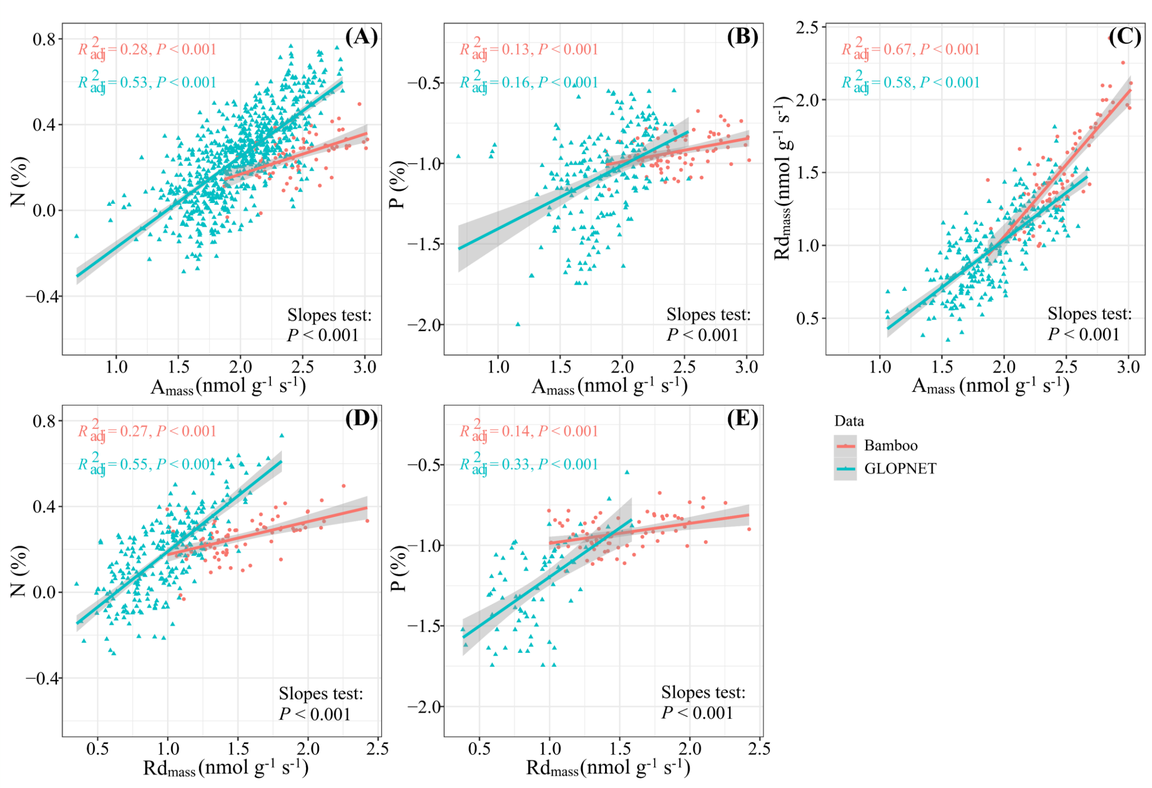


Figure 4 Bivariate trait relationships between leaf N, P, A_{mass}, Rd_{mass}.

- Wood bamboo functional traits clustered by organ;
- The A_{mass} and Rd_{mass} linked leaf traits with culm traits via GD.

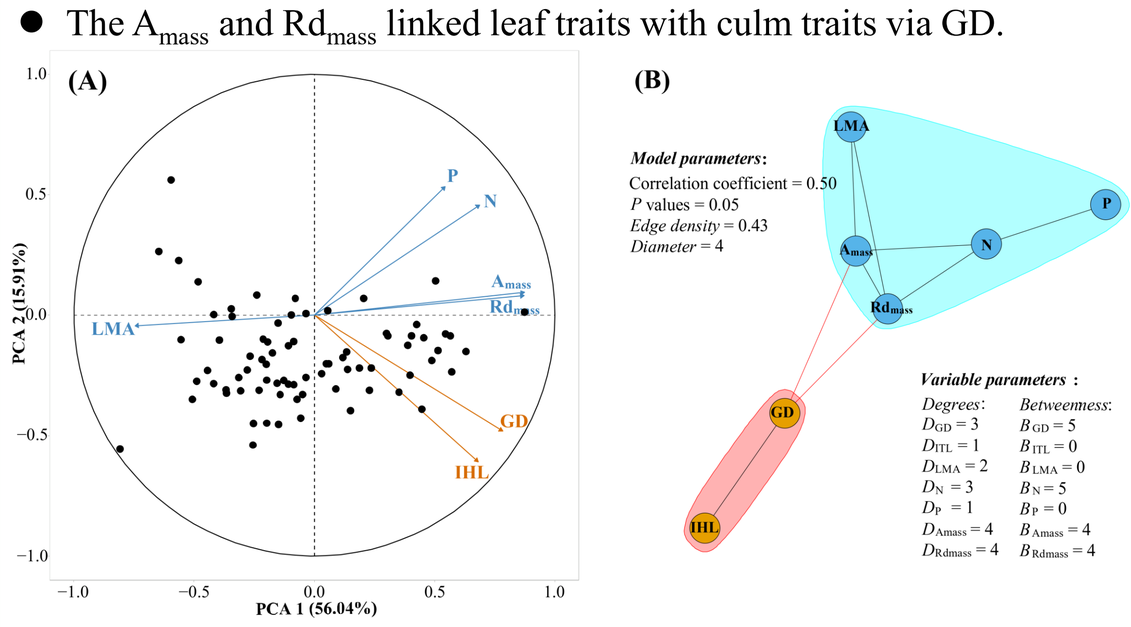
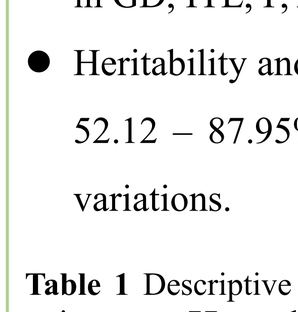


Figure 5 PCA (A) and network correlation (B) analyses of leaf and culm traits.

Conclusion

Leaf functional trait variations of woody bamboos were strongly affected by heritability; woody bamboo is a resource-acquisition taxon, with LES trade-offs in leaves; Amass and Rdmass linked leaf traits with culm traits via GD, other traits relatively independent. Our results provide a basis for studying functional traits tradeoff strategies and ecological adaptability of woody bamboo and increase the taxa of the global plant functional traits.



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