Beyond shading: litter production by neighbors contributes to overyielding in tropical trees

Appendix B

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Appendix B: Allometric relationships of total leaf-dry-mass used as a proxy for litter production

In order to develop neighborhood indices based on litter production by neighboring trees, we considered a tree's total leaf-dry-mass to be a good proxy for its litter production and established species-specific allometric relationships of total leaf-dry-mass.

Methods

To this end, we sampled ca. 300 trees to estimate their total fresh-leaf-mass in October 2010: the total number of branches was counted and total leaf-fresh-mass from two representative branches was measured. For 60 of these samples, leaves were dried to determine species-specific fresh to dry matter conversion ratios. For a tree of a given size, total leaf-dry-mass may vary among diversity treatments and is most likely influenced by small-scale variation in abiotic factors. To build better predictive models accounting for treatment effects and environmental heterogeneity, we compared, for each species, allometric models including no treatment effects, a diversity treatment effect (coded as a 3-level-factor: monoculture, 3-species mixture or 6-species mixture) or a neighborhood identity effect (coded as a 5-level-factor: monoculture, three different 3-species mixtures and 6-species mixture). Note that these factors incorporate environmental heterogeneity as well and are not forcibly diversity effects. Sample size was too low to incorporate plot effects. Models were selected based on AIC to avoid over-fitting.

Results

The protocol used to estimate total leaf mass produced satisfying allometric relationship of litter production in 4 species (R^2 ranging between 0.68 and 0.8 except for Ls, Table B1). It had limited accuracy for the most "branchy" species Ls. Consistent with a litter trap experiment that found increased litter production at the community in most 3-species mixtures (Scherer-Lorenzen et al., 2007), neighborhood identity effects ($NbID$) were retained for 4 species. Fresh to dry matter conversion yielded species-specific constants (0.41, 0.45, 0.24, 0.46 and 0.32 for Ae, Co, Ls, Hc and Tr respectively) with $R^2 > 0.99$.

Table B1: Species-specific allometric models for a tree's total leaf-dry-mass (LP). lBA denotes the log basal area. lBD designates the log basal diameter, that is the diameter at ground level. $NbID$ denotes neighborhood identity which was a coded as a 5-level-factor: monoculture, 3 different 3-species mixtures and 6-species mixture.

Species	Model	R^2
Ae	$\log LPAe \sim 1 + NbID + \log BA + (\log BA)^2$	0.72
Co	$\log LPCo \sim 1 + NbID + \log BA$	0.75
Hc	$\log LPHc \sim 1 + NbID + \log BD$	0.68
Ls	$\log LPLs \sim 1 + \log BA$	0.27
Tr	$\log LPTr \sim 1 + NbID + \log BA$	0.80

Literature cited

Scherer-Lorenzen, M., J. L. Bonilla, and C. Potvin. 2007. Tree species richness affects litter production and decomposition rates in a tropical biodiversity experiment. Oikos 116:2108 – 2124.