Carbon costs to acquire nitrogen are determined by interactions between nitrogen availability and light availability in two species with different acquisition strategies

Evan A. Perkowski; Elizabeth F. Waring; Nicholas G. Smith

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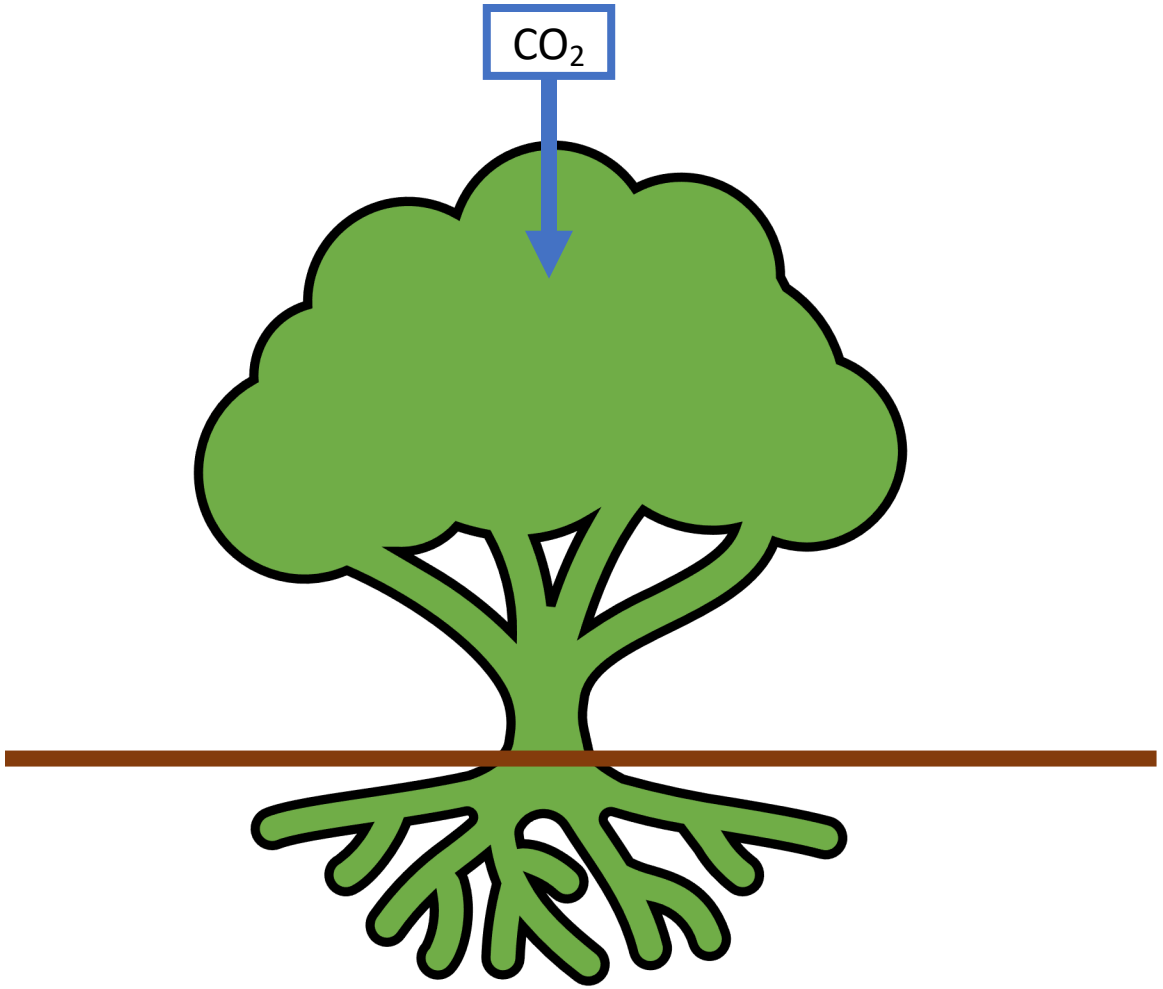
Plant nitrogen acquisition is a process in terrestrial systems where carbon and nitrogen are tightly coupled



Schematic adapted from Brzostek *et al*. (2014) *JGR Biogeosciences*

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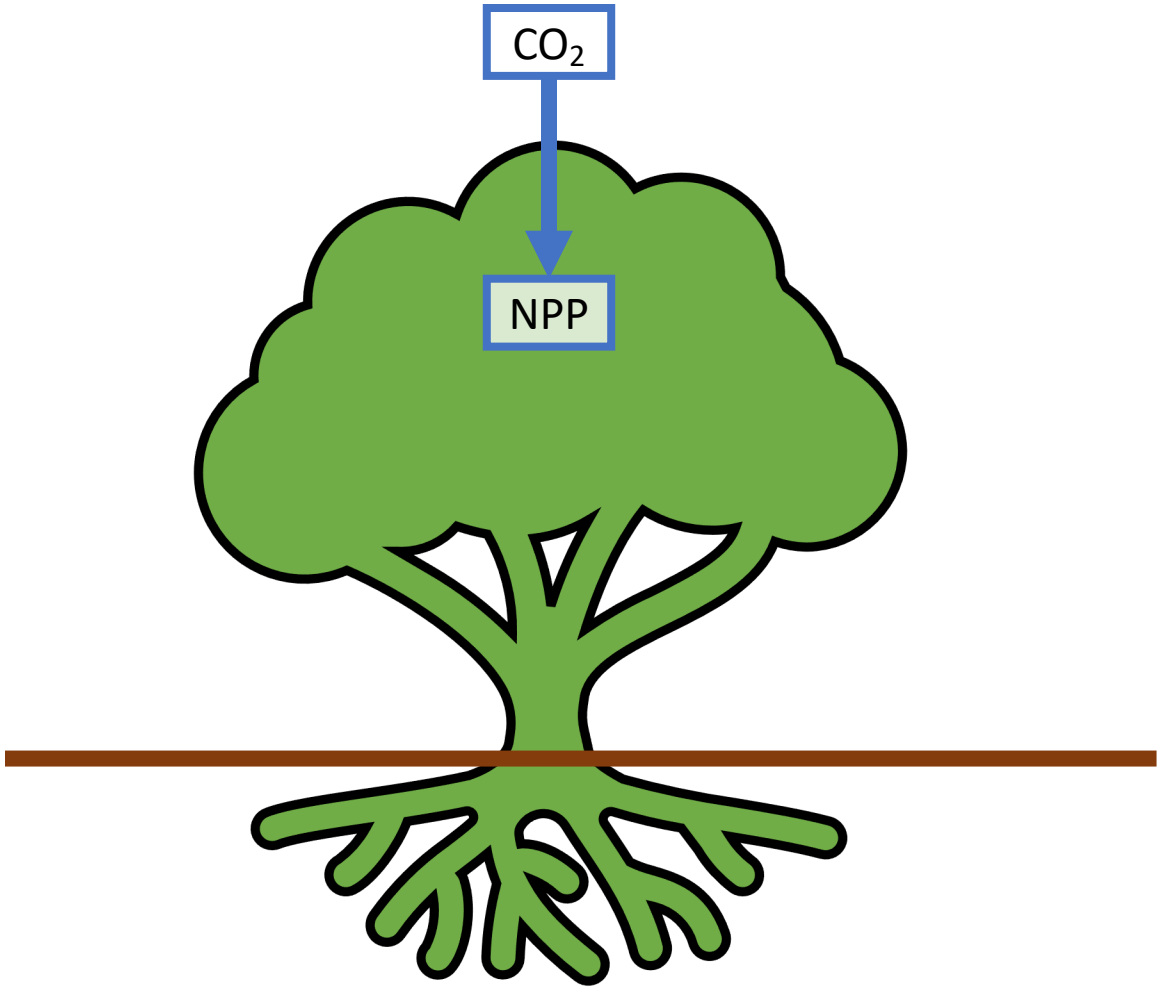

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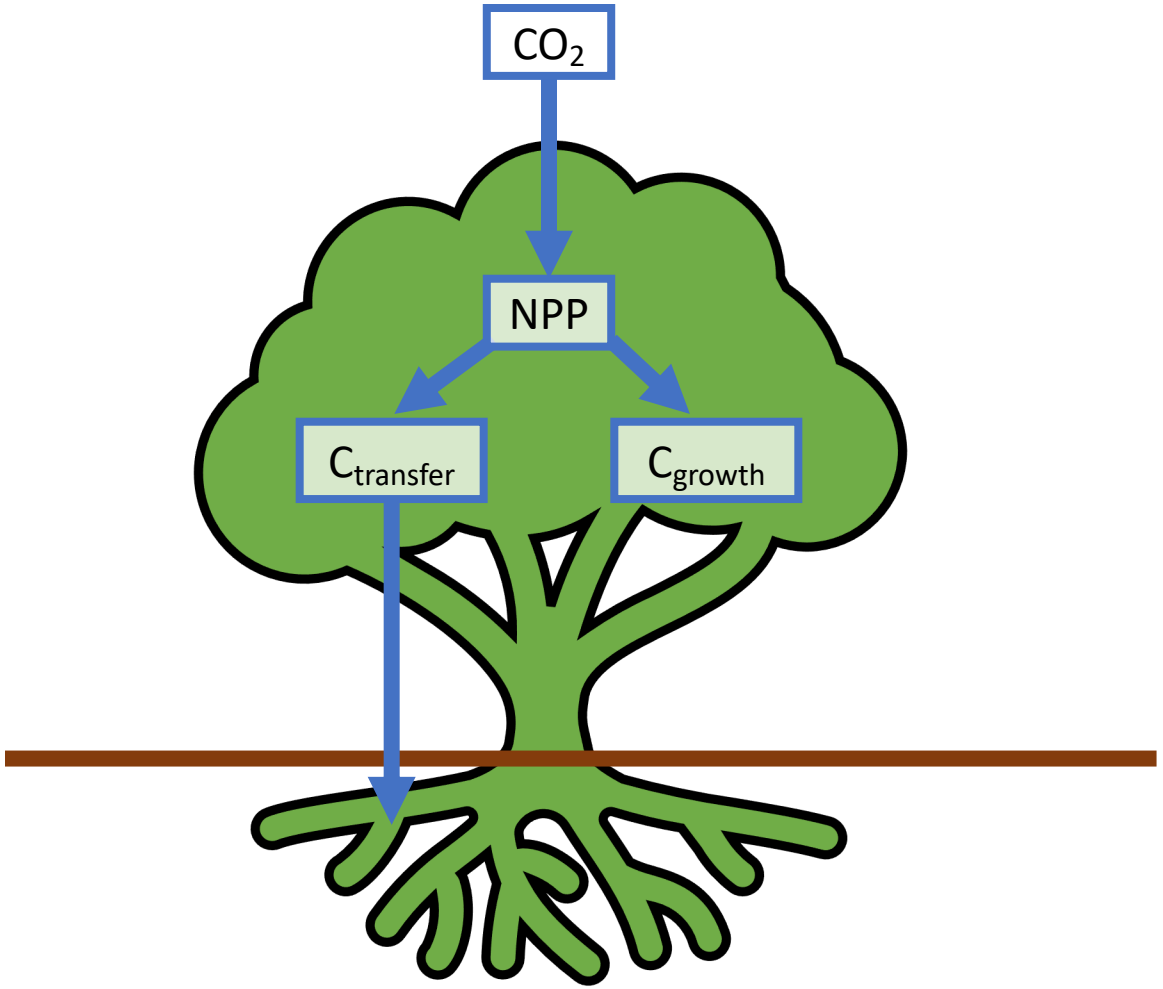

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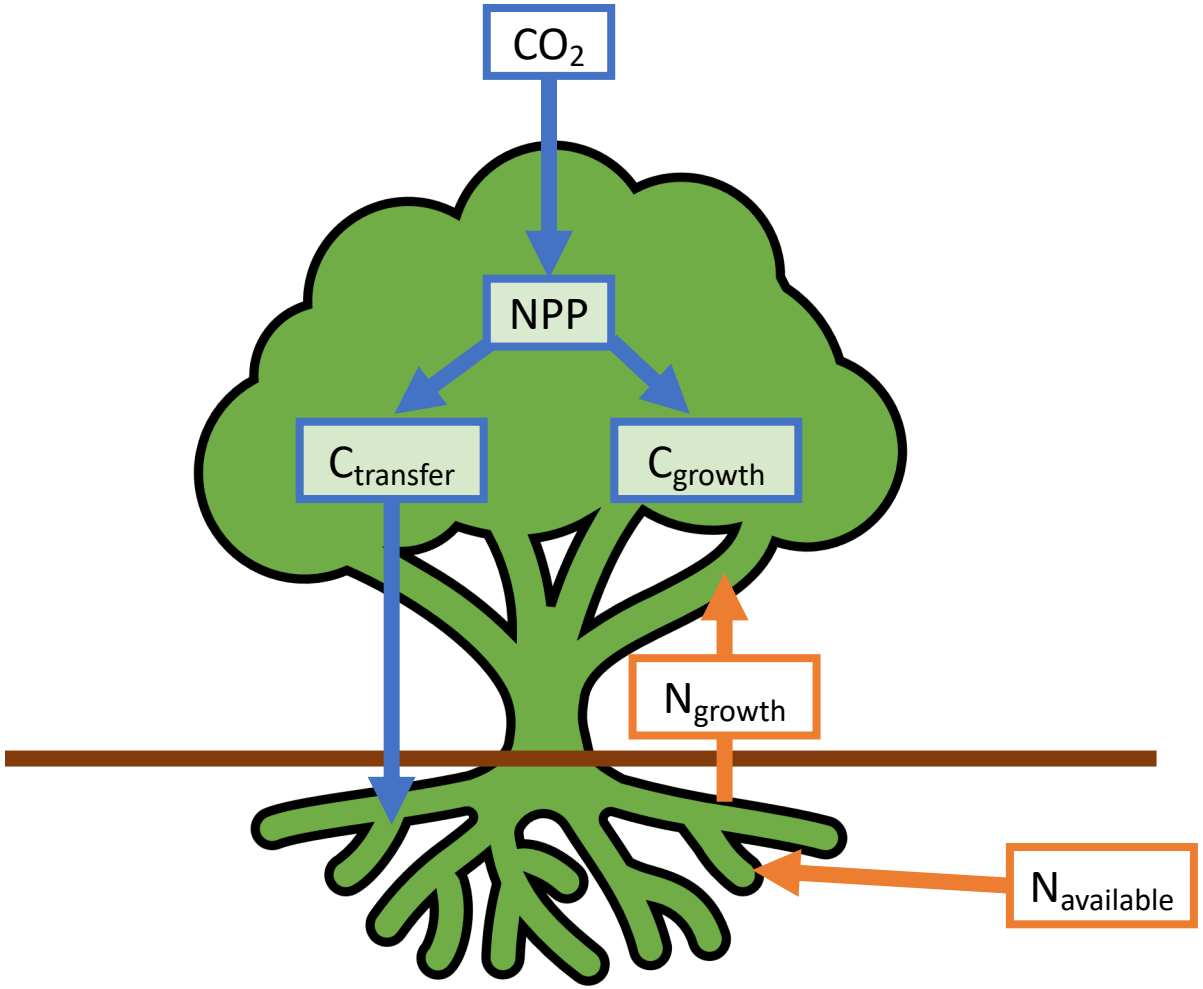

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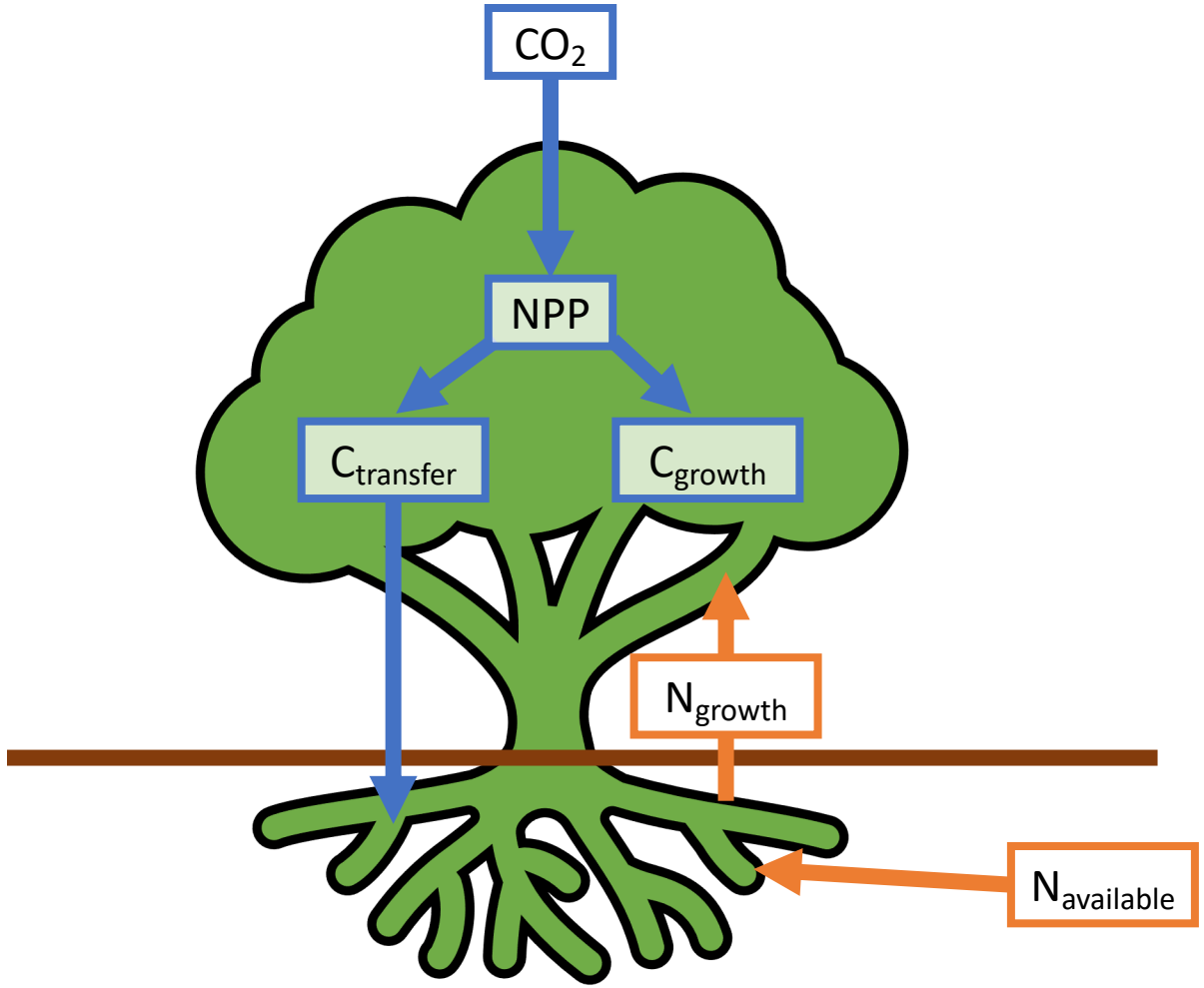
Plant nitrogen acquisition is a process in terrestrial systems where carbon and nitrogen are tightly coupled

There are inherent carbon costs associated with acquiring nitrogen



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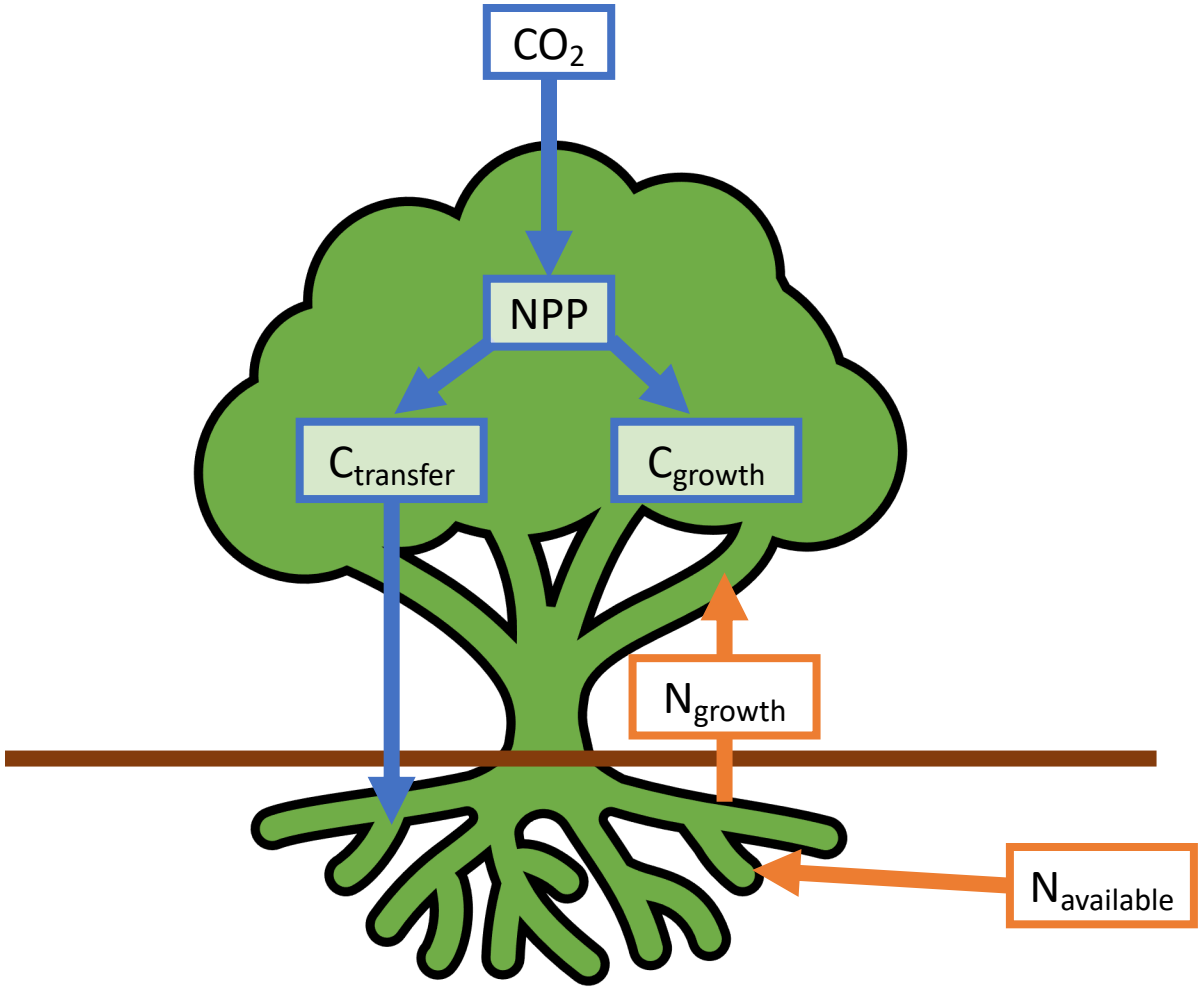
Soil nitrogen availability may decrease carbon costs to acquire nitrogen as a function of increased per-root nitrogen uptake



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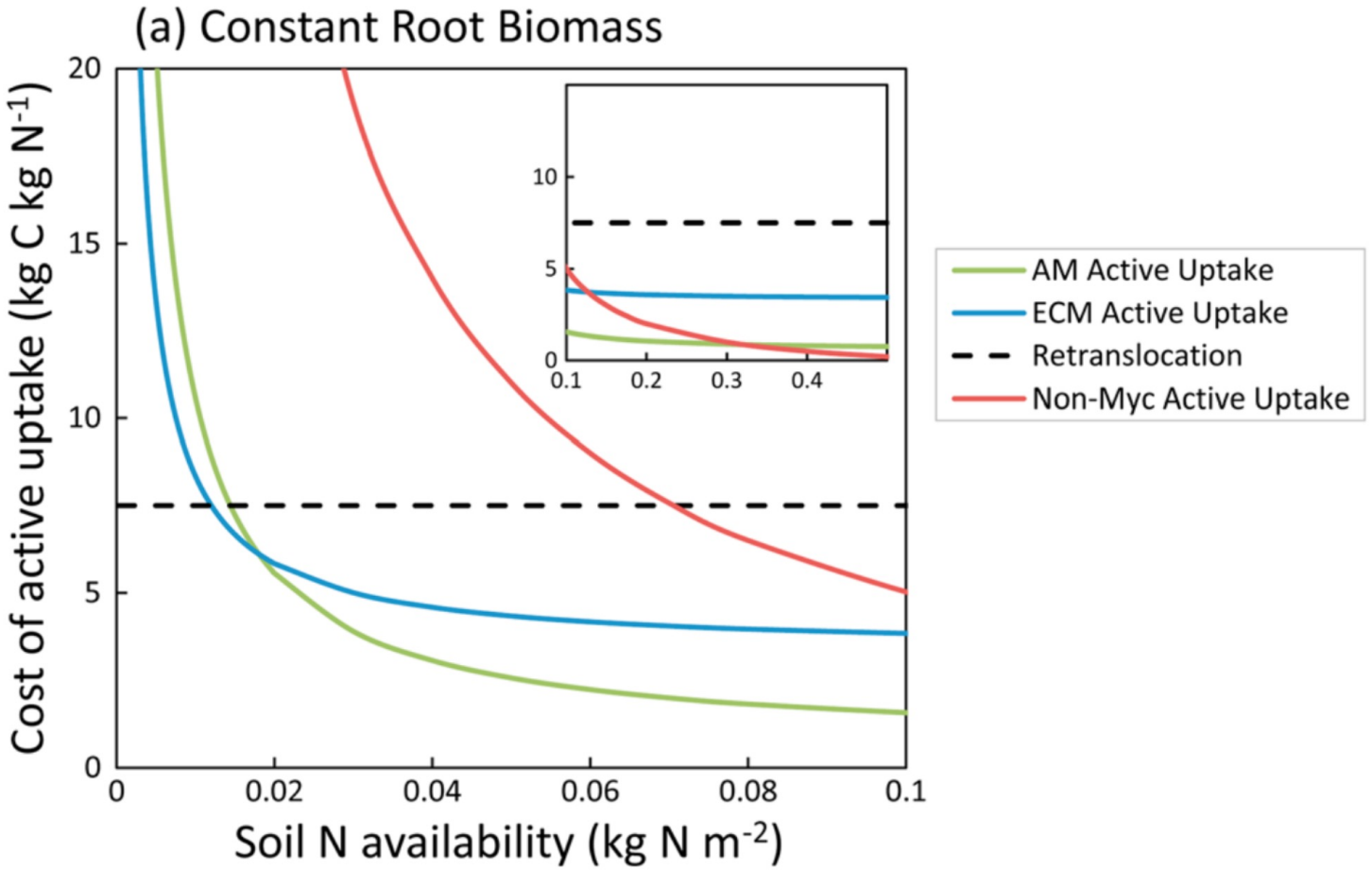
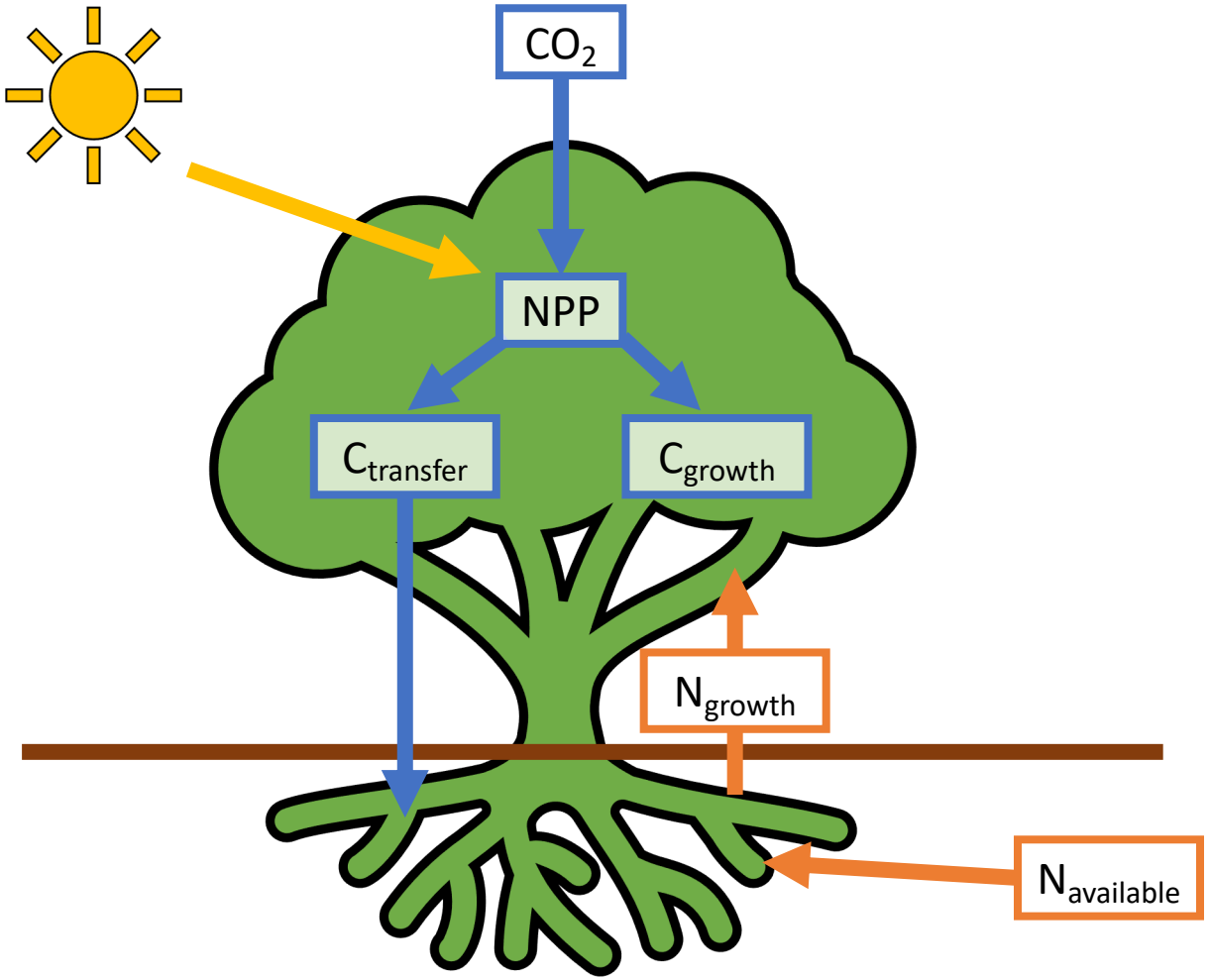
However, effects of soil nitrogen availability on carbon costs to acquire nitrogen may be context dependent on species nitrogen acquisition strategy



Brzostek *et al*. (2014) *JGR Biogeosciences*

Light availability may increase plant carbon costs to acquire nitrogen as a function of increased plant nitrogen demand



Increased plant nitrogen demand should increase belowground carbon investments

Over short temporal scales, this may not correspond with a simultaneous increase in plant nitrogen uptake

Primary Research Question

How does soil nitrogen availability and light availability influence plant carbon costs to acquire nitrogen?

Experimental setup

Light availability treatments	Soil fertilization treatments	Species
0% shade cover	0 ppm N	
30% shade cover	70 ppm N	*Gossypium hirsutum*
50% shade cover	210 ppm N	*Glycine max*
80% shade cover	630 ppm N	

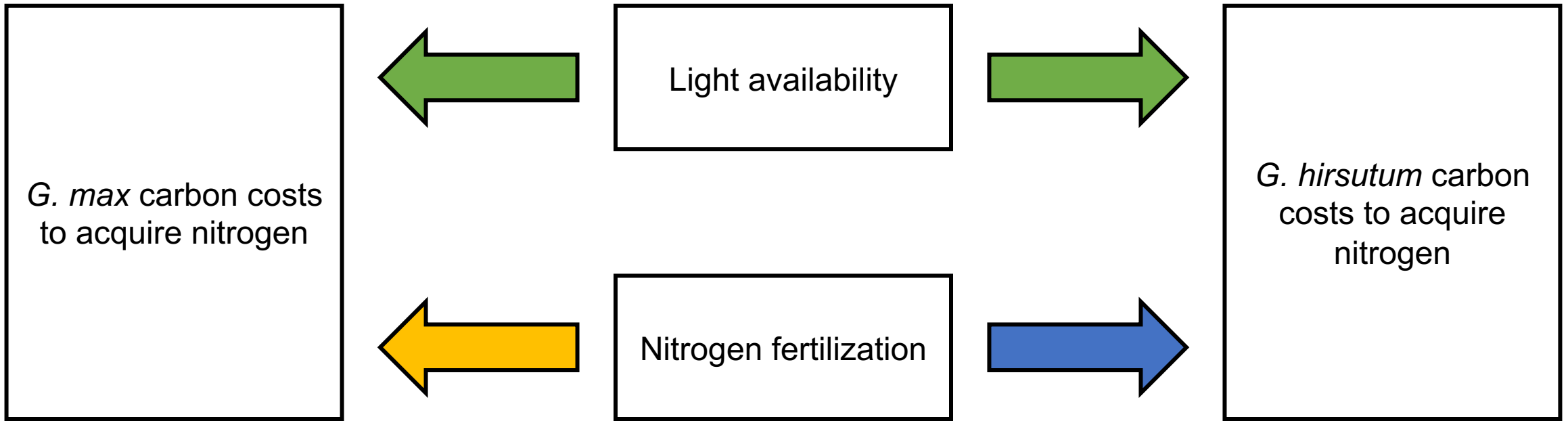
$$\text{Carbon cost to acquire nitrogen} = \frac{\text{Root carbon biomass}}{\text{Whole-plant nitrogen biomass}}$$

Hypotheses

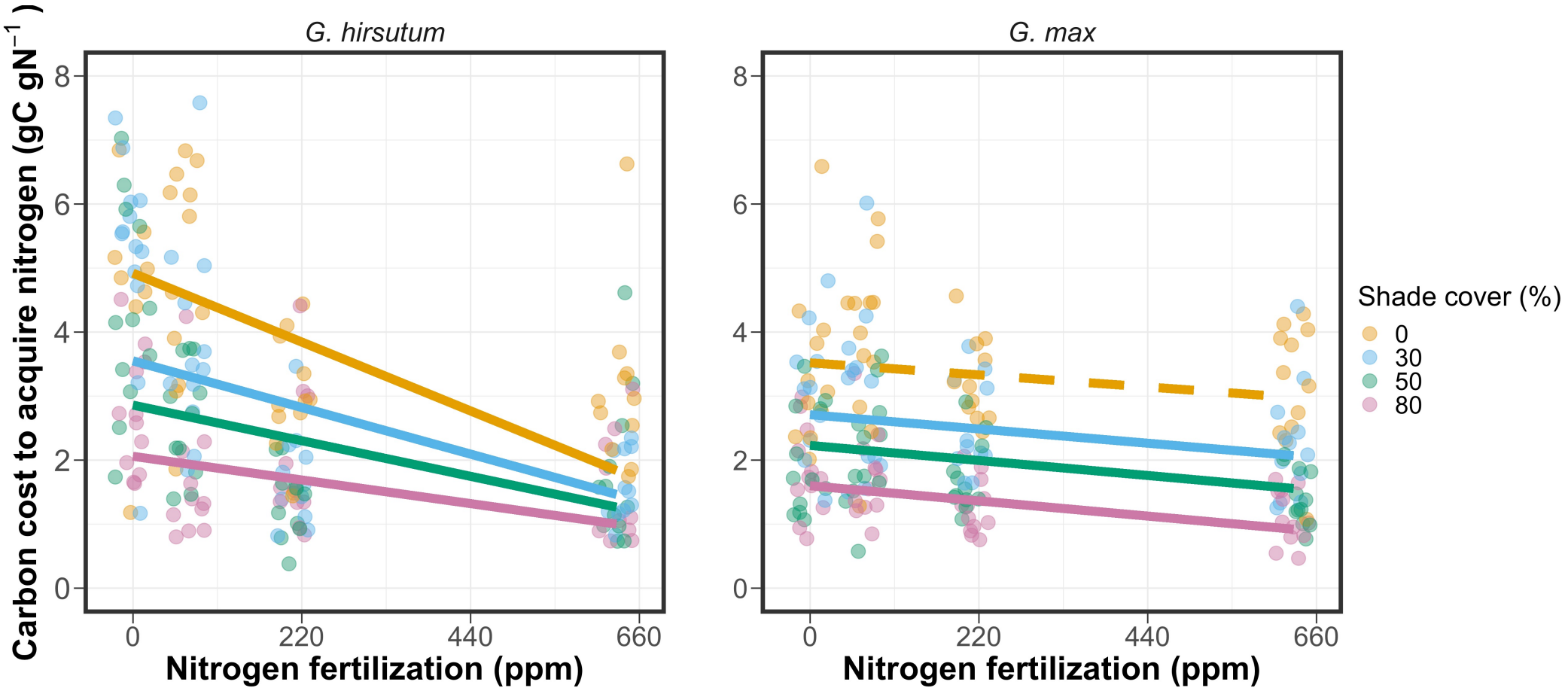
Positive effect

Neutral effect

Negative effect



Carbon costs to acquire nitrogen decreased with increasing nitrogen fertilization, but increased with increasing light availability



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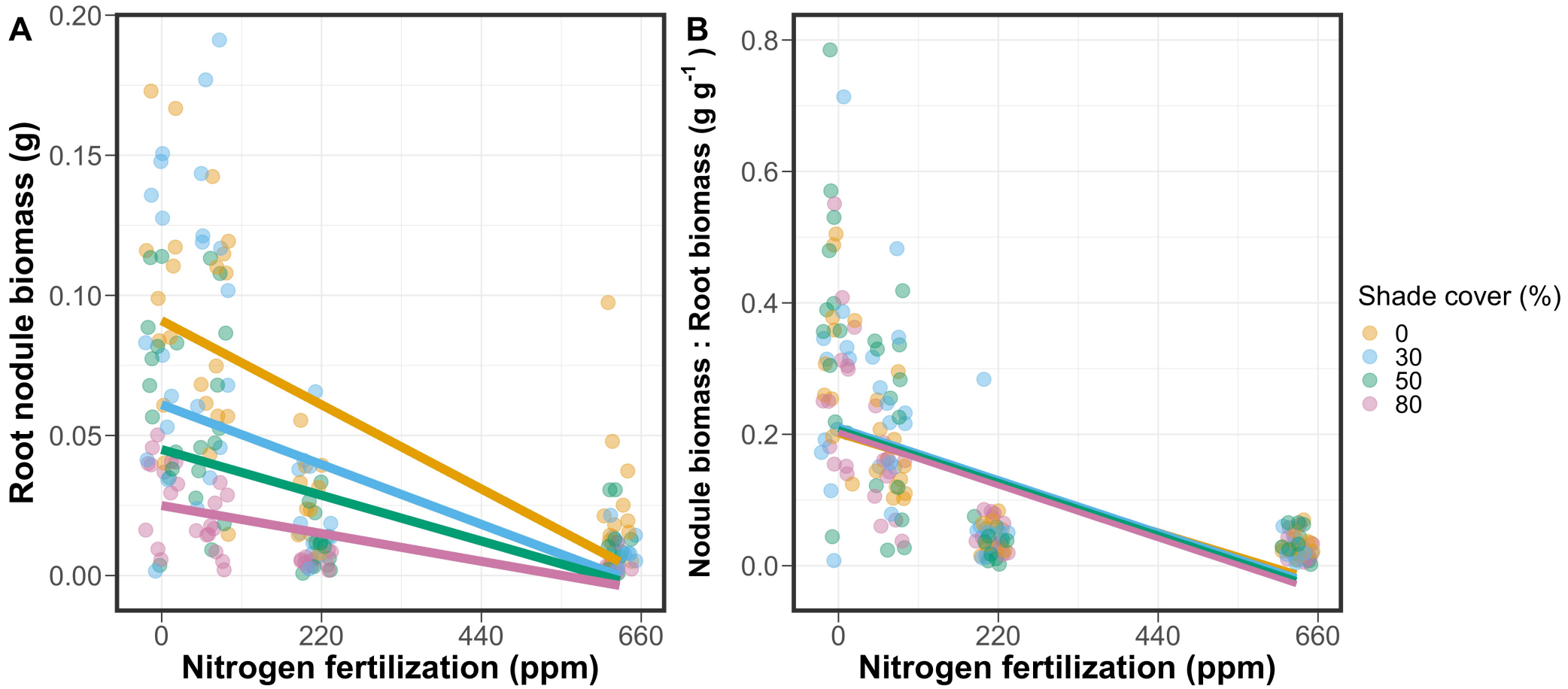
G. max decreased investment in root nodules with increasing nitrogen fertilization



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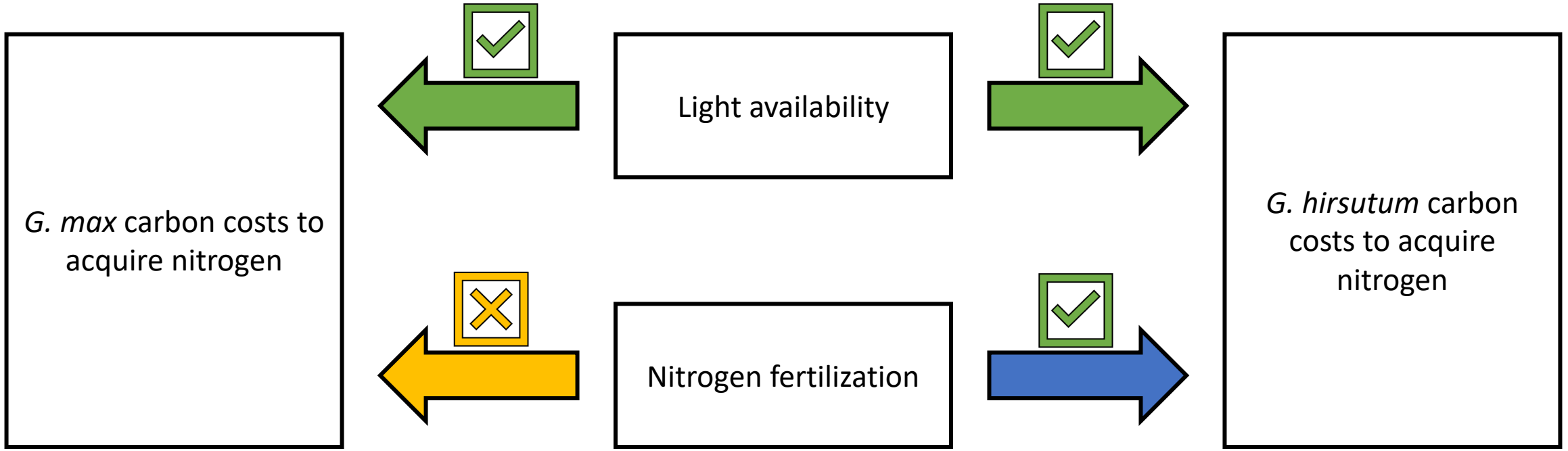
Summary of Findings



Future Work

- Larger range of taxonomically related species across multiple spatiotemporal scales to better understand generality of these patterns

- At what point do nitrogen-fixing species shift from nitrogen fixation to direct uptake? Is this in agreement with Earth system models?

Acknowledgements

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For more information about this work, scan the QR code to navigate to our recently accepted manuscript:

Thank you!