

University of Montana

## ScholarWorks at University of Montana

---

UM Graduate Student Research Conference (GradCon)

---

Apr 12th, 12:20 PM - 12:40 PM

### Symbiotic dinitrogen fixation enhances soil phosphorus acquisition strategies in tropical forests

Megan K. Nasto

*The University of Montana*, [megan.nasto@umontana.edu](mailto:megan.nasto@umontana.edu)

Silvia Alvarez-Clare

*The University of Montana*, [silvia.alvarez.clare@gmail.com](mailto:silvia.alvarez.clare@gmail.com)

Ylva Lekberg

*MPG Ranch*

Benjamin W. Sullivan

*The University of Montana*, [benjamin.sullivan@umontana.edu](mailto:benjamin.sullivan@umontana.edu)

Alan R. Townsend

*University of Colorado at Boulder*, [alan.townsend@colorado.edu](mailto:alan.townsend@colorado.edu)

*See next page for additional authors*

Follow this and additional works at: <https://scholarworks.umt.edu/gsrc>

## Let us know how access to this document benefits you.

---

Nasto, Megan K.; Alvarez-Clare, Silvia; Lekberg, Ylva; Sullivan, Benjamin W.; Townsend, Alan R.; and Cleveland, Cory C., "Symbiotic dinitrogen fixation enhances soil phosphorus acquisition strategies in tropical forests" (2014). *UM Graduate Student Research Conference (GradCon)*. 4.

<https://scholarworks.umt.edu/gsrc/2014/oralpres2a/4>

This Oral Presentation is brought to you for free and open access by ScholarWorks at University of Montana. It has been accepted for inclusion in UM Graduate Student Research Conference (GradCon) by an authorized administrator of ScholarWorks at University of Montana. For more information, please contact [scholarworks@mso.umt.edu](mailto:scholarworks@mso.umt.edu).

---

**Authors' Names**

Megan K. Nasto, Silvia Alvarez-Clare, Ylva Lekberg, Benjamin W. Sullivan, Alan R. Townsend, and Cory C. Cleveland

Symbiotic dinitrogen ( $N_2$ ) fixation – a process that allows some plants to overcome nitrogen (N) limitation by converting atmospheric  $N_2$  into bioavailable forms – is an energetically expensive mutualism that requires carbon and phosphorus (P) from host plants to support their microbial symbionts. Ecological theory suggests that  $N_2$  fixers – and  $N_2$  fixation – should have a competitive advantage in low N-high P environments, but be outcompeted – or down-regulated – in high N-low P environments. Yet,  $N_2$  fixers are relatively rare in N-poor temperate forests, but abundant and active in N-rich lowland tropical forests. Previous research addressing this paradigm hypothesized that  $N_2$  fixers have the capacity to acquire more soil P than non- $N_2$  fixers because they can invest fixed  $N_2$  in extracellular phosphatase enzymes, giving  $N_2$  fixers a competitive advantage in acquiring this often-limiting nutrient. We tested this hypothesis, as well as the potential ability for  $N_2$  fixers to host more arbuscular mycorrhizal (AM) fungi than non- $N_2$  fixers, by comparing enzyme activities and AM colonization between active  $N_2$  fixers and non- $N_2$  fixers in two lowland rainforest sites that compose a soil P gradient in Costa Rica. At both lowland rainforest sites, phosphatase enzyme activity and AM colonization were significantly greater on the roots of  $N_2$  fixers than non- $N_2$  fixers. Also, AM colonization was strongly and positively related to both  $N_2$  fixation rates and nodule biomass, and the nature of the relationships was similar between both lowland rainforest sites. This indicates a potential link between the two mutualistic strategies of acquiring soil N and P, though the mechanism enabling  $N_2$  fixers to host more AM fungi than non- $N_2$  fixers remains unclear. Overall, our results show a consistent set of N and P interactions across a range of plant species in two functional groups (i.e.,  $N_2$  fixers and non- $N_2$  fixers), and across a large gradient of soil total and extractable P that comprise the two lowland rainforest sites. Our results also suggest that the enhanced P acquisition strategies provide  $N_2$  fixers with a competitive advantage in nutrient acquisition across a wide range of soil nutrient conditions found in the tropics, and perhaps contributing to their relatively high abundance in tropical forests.