Stronger mutualism may lead to a higher susceptibility to parasitism

Nova Meng, Eunnuri Yi, Dr. Corlett Wood
nmeng@seas.upenn.edu

Abstract

The legume *Medicago truncatula* experiences a **genetic tradeoff** between attracting rhizobia (a mutualist) & repelling nematodes (a parasite) [1].
To further investigate this three way relationship, we blur the lines between mutualist and parasite by examining strains of mutualistic and cheating rhizobia.

Our primary question: **Are plants in a mutualistic relationship more susceptible to nematode infection?**

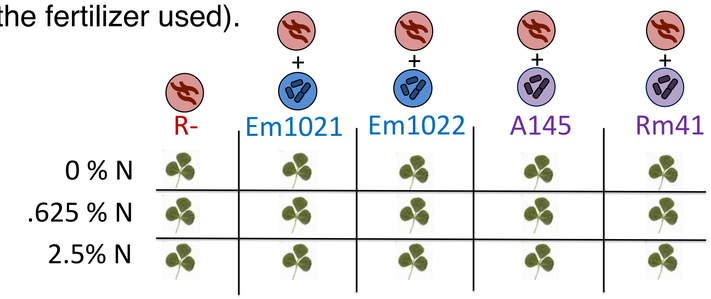
Methodology

Nematodes are **parasitic worms** that steal nutrients. *(Meloidogyne hapla)*

Rhizobia are a **mutualistic bacteria** that fix nitrogen for legumes in exchange for nutrients. (*Sinorhizobium meliloti*)

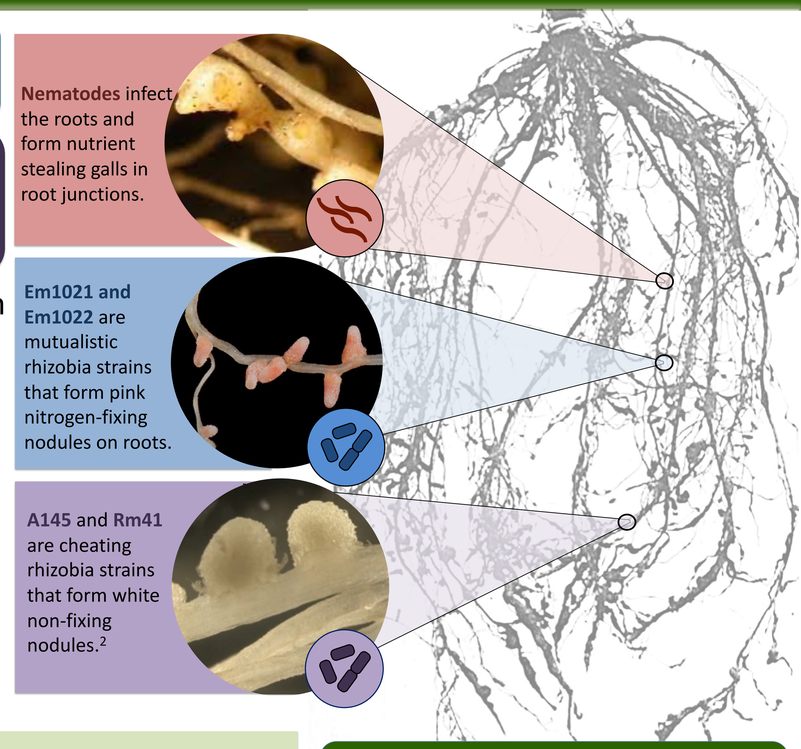
Some strains of rhizobia cheat and do not fix nitrogen.

We performed a **greenhouse experiment** on **A17 *Medicago truncatula*** with **5 rhizobia treatments** (4 with both rhizobia and nematodes and 1 with just nematodes) with **3 nitrogen treatments** (defined by the percent nitrogen in the fertilizer used).



x 8

N = 120
(8 repetitions per rhizobia treatment per nitrogen treatment)



1 A145 and Rm41 cheat more than Em1021 and Em1022.

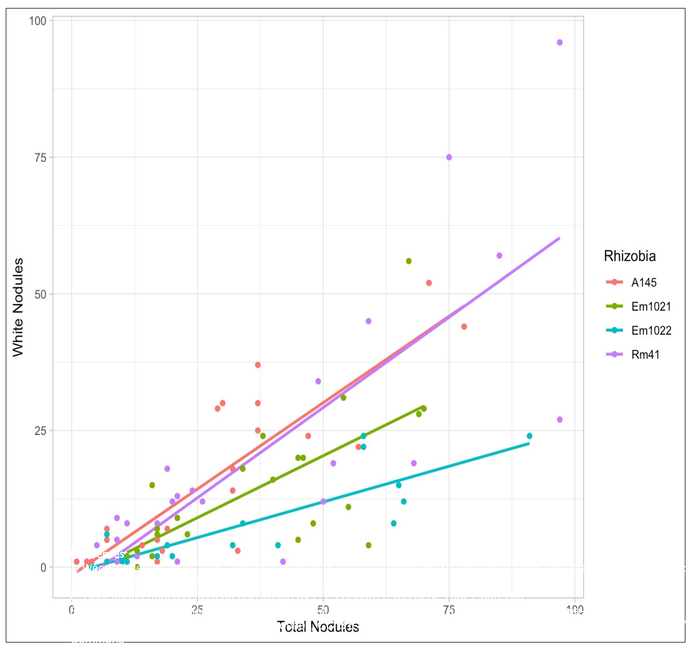


Fig. 1 shows the ratio of white non-fixing nodules to total nodules for each strain of rhizobia.

2 Plants with a sufficient nitrogen content are less open to mutualism.

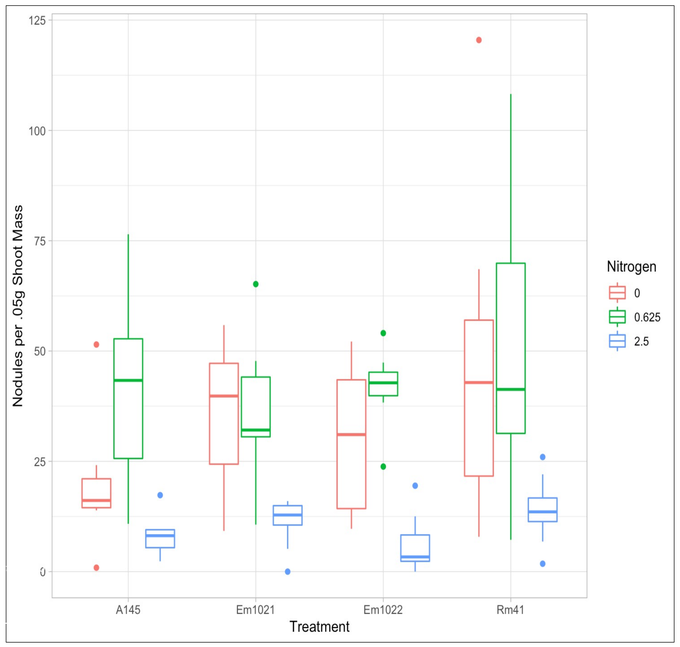


Fig. 2 shows the nodules per .05g shoot mass in order to adjust for the differences between plant health between nitrogen treatments.

3 Rhizobia treatment may affect plant growth.

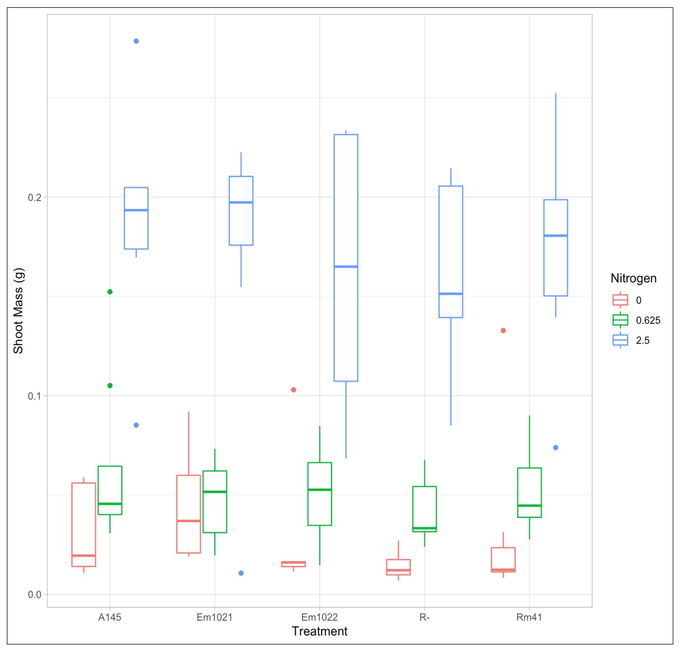


Fig. 3 shows the relationship between treatment and the resulting shoot mass.

Conclusions

Each strain of rhizobia alters both the development of nodules and the development of the overall plant. There is more room to investigate that the fixing vs. cheating nature may have a significant effect on the susceptibility towards nematode infection, but further data must be collected like gall count and nitrogen content.

Next Steps

- How were the nematodes of each treatment affected by the different strains?
- How much nitrogen did each strain produce?

References
1. Wood, Corlett W., et al. 2018. "Genetic Conflict with a Parasitic Nematode Disrupts the Legume-Rhizobia Mutualism." *Evolution Letters*, vol. 2, no. 3, 2018, pp. 233–245., doi:10.1002/evl3.51.
2. Root image adapted from an 698 image by L.T. Leonard (Fred et al. 1932). 699 700.
3. Yang, Shengming, et al. "Microsymbiont Discrimination Mediated by a Host-Secreted Peptide in Medicago Truncatula." Proceedings of the National Academy of Sciences, Proceedings of the National Academy of Sciences, June 2017, p. 201700460. Crossref, doi:10.1073/pnas.1700460114.
4. Image of non-fixing nodules from Westhoek, A., Field, E., Rehling, F. et al. Policing the legume-Rhizobium symbiosis: a critical test of partner choice. Sci Rep 7, 1419 (2017). https://doi.org/10.1038/s41598-017
5. Image of fixing nodules from Ninjatacoshell, CC BY-SA 3.0<https://creativecommons.org/licenses/by-sa/3.0>, via Wikimedia Commons
6. Image of galls taken by Scott Nelson <https://www.flickr.com/photos/scotnelson/36951196620>

Acknowledgements
Thank you to Eunnuri Yi and Dr. Corlett Wood for providing guidance and mentorship in the research path and experimental design.
Thank you to Yoon Chang , Chigozie Ibe , and Eunnuri Yi for counting nodules.
Thank you to Penn Undergraduate Research Mentorship Program for the generous funding.