Effects of parasites on plant-microbe mutualism differs between microbial strains

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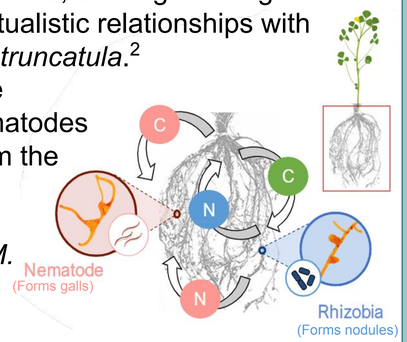
Introduction

The presence of parasites reduces the benefits of mutualistic relationships.[1] This project aims to quantify how much of an effect parasites have on the mutualistic relationships and if the magnitude of this effect differs between the genotypes of the partners.

Background

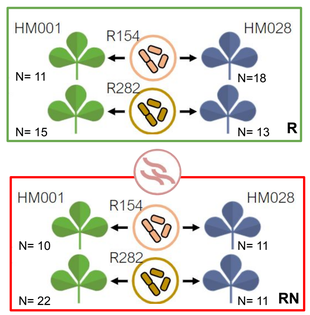
- *Ensifer meliloti* are rhizobia, a nitrogen-fixing bacteria, that form mutualistic relationships with the legume *Medicago truncatula*.[2]
- *Meloidogyne hapla* are parasitic root-knot nematodes that steal nutrients from the plant.[2]
- Both nematodes and rhizobia interact with *M. truncatula* through the roots.[2]

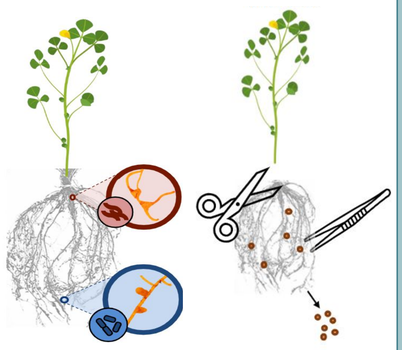


Methods

Two plant genotypes grown in nitrogen-free sand were inoculated with one of two different strains of rhizobia. Plants in the RN treatment group were further infected with nematodes.

Plants were harvested. Aboveground biomass, nodule number, nodule weight, and gall number were collected for each plant.





Results

1. Rhizobia genotype affects plant fitness during nematode infection.

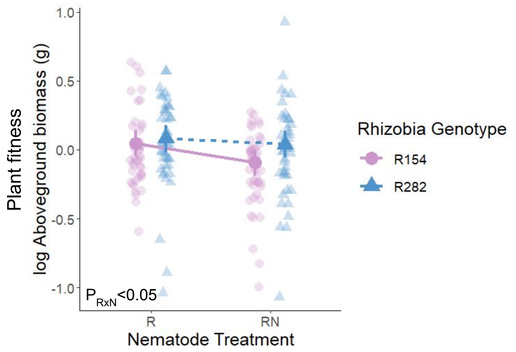


Fig. 1. Plants inoculated with R282 had little change in aboveground biomass when infected with nematodes. However, plants inoculated with R154 had a decrease in aboveground biomass.

2. Rhizobia fitness in the presence of nematodes differs between rhizobia genotype.

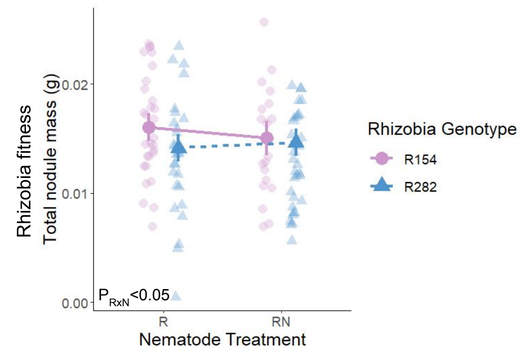


Fig. 2. Nodule mass remained the same for plants inoculated with R282. However, plants inoculated with R154 had a decrease in nodule mass when infected with nematodes.

3. Susceptibility to nematode infection does not differ between plant and rhizobia genotype.

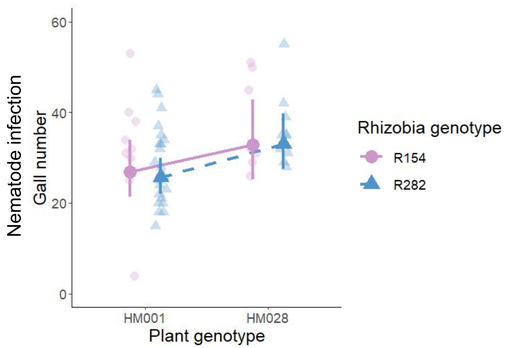


Fig. 3. There is no significant difference between the number of galls on different rhizobia and plant genotype combinations.

4. Nematodes do not affect overall relationship between plants and rhizobia.

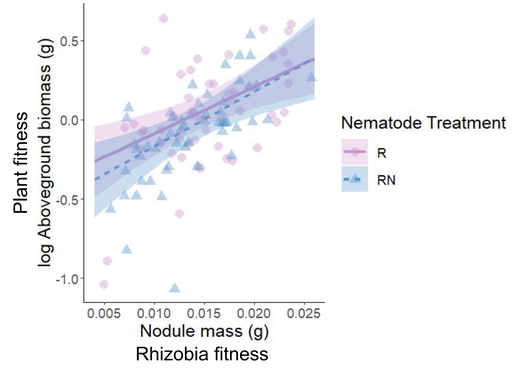


Fig. 4. There is no significant difference in the amount plant benefits per nodule between the two nematode treatments.

Discussion

- Nematodes reduce the fitness of both mutualistic partners.
- The effect nematodes have on plant and rhizobia fitness differs between rhizobia strains.
- The overall benefit that plants receive per nodule is unchanged by nematodes. This suggests that although nematodes are affecting plant and rhizobia fitness, they do not affect the plant-rhizobia relationship.
- Plants or rhizobia could be increasing their resource exchange in order to rescue the fitness of both partners.

Future Directions

We will conduct an elemental analysis to look at the nutrient exchange of carbon and nitrogen between plants and rhizobia. This will allow us to test if the partners are increasing cooperation to rescue the overall fitness.

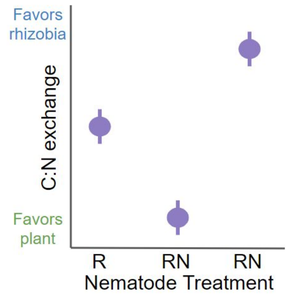


Fig. 5. These are the potential outcomes for this analysis. The C:N exchange values indicate which partner is receiving more benefit from the mutualism.

References

1. Wood et al. *Evolution Letters* 2, 233-245 (2018).
2. Oldroyd et al. *Annual Review of Genetics* 45, 119-144 (2011).

Acknowledgements

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