Can we increase the nitrogen fixation efficiency of Sinorhizobium meliloti?
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Introduction
Rhizobia are soil bacteria that can grow and reproduce in legume root nodules (Fig. 1). They use carbohydrates from their host plant for reproduction and also to fix nitrogen (N2 → NH3) for the host. The amount of nitrogen fixed per its carbon cost is defined as nitrogen fixation efficiency. Nitrogen fixation can amount up to $37.50 per acre. However, rhizobia are not always fixing nitrogen at maximum efficiency. In alfalfa nodules, nitrogen-fixing rhizobia lose the ability to reproduce and don’t hoard carbon. However, they may divert resources from nitrogen fixation to rhizopine production, which can be used as an additional carbon source for still-reproductive rhizobia in the same nodule. Consequently, these rhizopine producing rhizobia might thrive at the host’s expense and harm agriculture.

Materials and Methods
I measured the nitrogen-fixation efficiency of four genetically different strains of rhizobia to see if it’s actually affected by rhizopine production. Of the four strains of rhizobia tested, two strains synthesized rhizopines and two strains did not. To test the efficiency of a strain, I measured how much carbon dioxide (from respiration) and atmospheric hydrogen (a byproduct of nitrogen fixation) were released by nodules as a function of oxygen concentration.

Data

Conclusions
There was a difference in nitrogen fixation efficiency among the strains tested. One rhizopine (+) strain (from the wild) had a lower nitrogen fixation efficiency than the other strains, but a rhizopine(-) lab strain did not. Thus, rhizopine production itself may not divert significant resources from nitrogen-fixation. This could be tested with strains that were genetically identical except for the rhizopine production gene.

Future Research
In the near future, I will evaluate the fitness of nodule-occupying rhizobia from plants that were inoculated with a mixture of rhizopine (+) and rhizopine (-) strains.

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Literature cited
