

# The dynamic consequences of invasion: negative plant-soil feedbacks on natives increase over the time course of invasion

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## INTRODUCTION

Exotic species can negatively impact native community members, directly through competition, or indirectly by altering interactions between native species and other community members, such as pathogens and mutualists. Soil microbial communities have been shown to respond to invasive species, yet **microbe-mediated effects of invasives on natives may take time to develop and may change throughout the invasion process**. Few studies have investigated how species interactions between natives and exotics change during invasions.

## HYPOTHESES

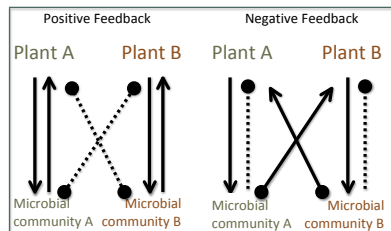
1. Invasive species will decrease seedling survival and growth in a native species by changing the soil microbial community through plant-soil feedbacks (PSF).
2. The strength of PSF will intensify over the course of an invasion.



## METHODS

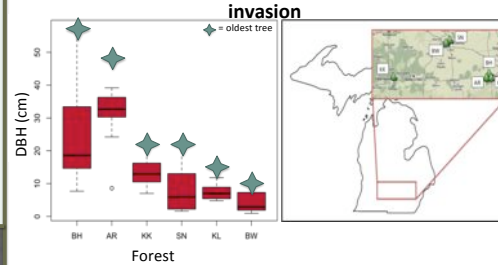
*Acer platanoides* (Norway maple) was introduced into the US from Europe in 1756 and has since invaded intact forests, lowering understory diversity and inhibiting native tree species regeneration.

We collected soil samples from beneath the canopies of *A. platanoides* and *A. saccharum* in Michigan forests that had been invaded by *A. platanoides* for varying time periods. (n = 10 trees / species / forest ; 6 forests).

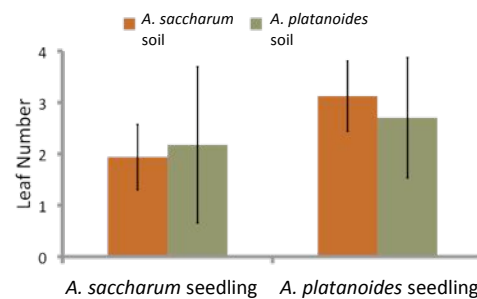


In the greenhouse, we inoculated seedlings of *A. platanoides* and *A. saccharum* with conspecific and heterospecific microbial communities to determine how the soil community affects seedling survival and growth. Seedlings were grown for 4 months. We measured survival, height, above and below ground biomass, and leaf number to determine seedling performance.

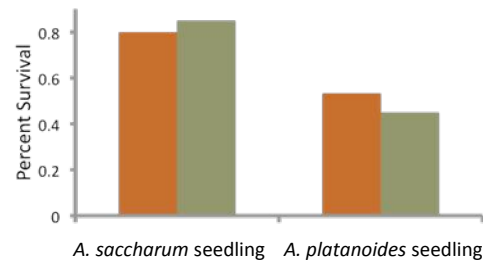
The oldest (>DBH) *A. platanoides* present in each forest was used to determine relative ages of invasion



Seedlings tended to have higher growth and survival when grown in heterospecific as compared to conspecific soils (-PSF)

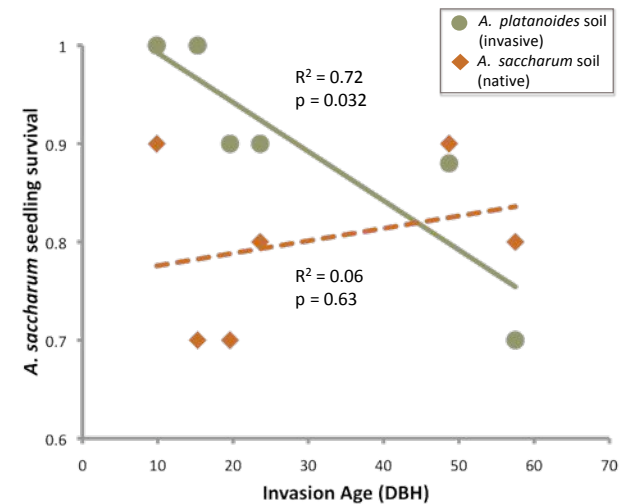


*A. platanoides* seedlings had increased growth (more leaves) when grown in soil communities collected from the native *A. saccharum*, but *A. saccharum* seedlings had reduced growth when grown in conspecific soil (seedling \* tree soil,  $p = 0.044$ . Error bars represent standard deviations).



Overall, *A. saccharum* seedlings had highest growth and survival when grown in *A. platanoides* soil (logistic regression of survival: forest  $p = 0.02$ ; seedling  $p < 0.001$ ; tree soil \* seedling  $p = 0.09$ ).

Microbe-mediated negative effects of *A. platanoides* on *A. saccharum* increased over the time course of invasion



*A. saccharum* survival was lowest when inoculated with *A. platanoides* soil from old invaded sites. We found a negative correlation between invasion age and *A. saccharum* seedling survival when grown in *A. platanoides* soils, yet there was no correlation between invasion age and survival when grown in *A. saccharum* soils.



## CONCLUSIONS

These results show the microbial community cultivated by an invader alters the performance of a native plant species, and its effect increases over the course of an invasion. Both the native *A. saccharum* and exotic *A. platanoides* experienced negative PSFs, and grew best in heterospecific soils, but this benefit for *A. saccharum* disappeared in older invasions. In future work, we plan to identify changes in microbial community composition and the relative abundances of mutualists versus antagonists in response to invasion to identify potential mechanisms underlying PSF.

## ACKNOWLEDGEMENTS

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