**Introduction**

[what we’ve learned from TT so far]

[open questions about the study system]

Here, we collected gas exchange and chlorophyll fluorescence data from two native understory perennial species (*Trillium erectum* L. and *Maianthemum racemosum* L.) growing in a long-term *Alliaria petiolata* removal experiment to assess effects of *A. petiolata* invasion on native species physiology. Data were collected at two separate timepoints: (1) when the upper canopy was open and demand for soil resources was presumably high, and (2) when the upper canopy was closed and demand for soil resources was presumably low. We used these data to address the following hypotheses:

1. *A. petiolata* invasion will negatively impact native species’ photosynthetic capacity. This response will be associated with reorganized belowground microbial communities that will decrease provisioning of soil resources to native species
2. Negative effects of *A. petiolata* invasion will be most prominent when the upper canopy is open, as greater demand to build and maintain photosynthetic enzymes will enhance negative effects of inhibited plant-AM fungal symbioses
3. Of the two native species, *A. petiolata* invasion will more negatively affect photosynthetic capacity in *M. racemosum*, as *M. racemosum* emerges later than *T. erectum* and will therefore rely more strongly on plant-AM fungal symbioses for nutrient and water acquisition.

**Methods**

*Study site and experimental design*

This study was conducted in a long-term garlic mustard (*Alliaria petiolata*) removal experiment at Trillium Trail Nature Reserve in Fox Chapel, PA (40.520 °N, -79.901 °W). The study, which has been in operation since 2006, boasts steep slope grades ranging from 25-75%, with soils at the site broadly classified as Gilpin-Upshur-Atkins soils with dominant shale, sandstone, and red clay shale bedrock components. Mean annual precipitation and mean annual temperature (2006-2020) of the study site is XX mm yr-1 and XX °C, respectively (CITE).

Fences were set up in 2002 at five 14 x 14 m experimental plots to exclude deer. Since 2006, *Alliaria petiolata* has been manually weeded from the left half of each experimental plot, with the right half of each plot left unweeded.

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*Leaf gas exchange measurements*

Net photosynthesis (*A*net; μmol m-2 s-1), stomatal conductance (*g*sw; mol m-2 s-1), and intercellular CO2 (*C*i; μmol mol-1) concentrations were measured across a range of atmospheric CO2 concentrations (i.e., an *A*net/*C*i curve) using the Dynamic Assimilation™ Technique (Saathoff and Welles, 2021). *A*net/*C*i curves were generated along a reference CO2 ramp down from 420 µmol mol-1 CO2 to 20 µmol mol-1 CO2, followed by a ramp up from 420 µmol mol-1 CO2 to 1620 µmol mol-1 CO2 after a 90-second wait period at 420 µmol mol-1 CO2. The ramp rate for each curve was set to 200 μmol mol-1 min-1, logging every five seconds, which generated 96 data points per response curve. All *A*net/*C*i curves were generated after *A*net and *g*sw stabilized in a LI-6800 cuvette set to a 500 mol s-1 flow rate, 10000 rpm mixing fan speed, 1.5 kPa vapor pressure deficit, 25°C leaf temperature, 2000 μmol m-2 s-1 incoming light radiation, and initial reference CO2 set to 420 µmol mol-1. Snapshot *A*net, *g*sw, and leaf *C*i:*C*a measurements were extracted from each *A*net/*C*i curve at 420 µmol mol-1 CO2 (*A*net,420; μmol m-2 s-1). Intrinsic water-use efficiency (*i*WUE; μmol CO2 mol-1 H2O) was calculated as the ratio of *A*net to *g*sw.

*A/Ci curve fitting and parameter estimation*

*A*net/*C*i curves were fit using the ‘fitaci’ function in the ‘plantecophys’ R package (Duursma, 2015). This function estimates the maximum rate of Rubisco carboxylation (*V*cmax; µmol m-2 s-1) and maximum rate of electron transport for RuBP regeneration (*J*max; µmol m-2 s-1) based on the Farquhar *et al.* (1980) biochemical model of C3 photosynthesis. Triose phosphate utilization (TPU) limitation was included as an additional rate-limiting step in all curve fits after visually observing clear TPU limitation for most curves. Dark respiration was also estimated in curve fits as a fixed proportion of *V*cmax. We determined Michaelis-Menten coefficients for Rubisco affinity to CO2 (*K*c; μmol mol-1) and O2 (*K*o; mmol mol-1), and the CO2 compensation point *(Γ*\*; μmol mol-1) using leaf temperature and equations derived in Bernacchi et al. (2001). Specifically, *K*c *K*o, and *Γ*\* were each calculated as:

(1a)

(1b)

(1c)

In all three equations, *T*k is the leaf temperature (in Kelvin) during each *A*net/*C*i curve and R is the universal gas constant (8.314 J mol-1 K-1).

*Chlorophyll fluorescence*

A MultispeQ device (PhotosynQ, Lansing, MI, USA) was attached to leaves after *A*net/*C*i curves were produced.

*Data analysis*

To investigate the role of