Photosynthetic Decline in Aging Perennial Grass is Not Fully Explained by Leaf Nitrogen

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Background/Objective

- *Do plants age?* Leaf photosynthesis in perennial grasses declines with whole-plant age. Juvenile plants tend to have higher photosynthetic rates than mature individuals. These changes could be related to nitrogen (N) limitations in larger mature plants (Fig.1).
- This study sought to understand the influence of N limitation on photosynthetic decline in the perennial grass *Miscanthus* × *giganteus* (*M*×*g*) with age.

Approach

In each of three planting years (2015, 2016, 2017) *M*×*g* was planted at five N application rates (0, 112, 224, 336, 448 kg/ha) in four replicate blocks. Photosynthetic gas exchange, chlorophyll fluorescence, and leaf N per unit area were measured every two weeks from summer through late fall.

Results

Mature *M*×*g* stands had 19-35% lower leaf photosynthesis than juvenile stands and had 14-34% lower leaf N. N fertilization increased leaf photosynthesis in mature stands, at times up to juvenile photosynthesis levels, but this increment was largely driven by a disproportionately larger change in leaf N (Fig. 2). Leaf photosynthesis per unit of leaf N was about 25% lower in mature stands than juvenile stands across all N fertilization rates.

Significance/Impacts

Results of this work suggest that other factors besides N limit photosynthesis in mature *M*×*g* stands. We hypothesize that sink limitations may become a stronger driver of age-related changes as *M*×*g* stands mature.

Tejera et al. 2022. "Photosynthetic Decline in Aging Perennial Grass is Not Fully Explained by Leaf Nitrogen." *Journal of Experimental Botany.* DOI: 10.1093/jxb/erac382

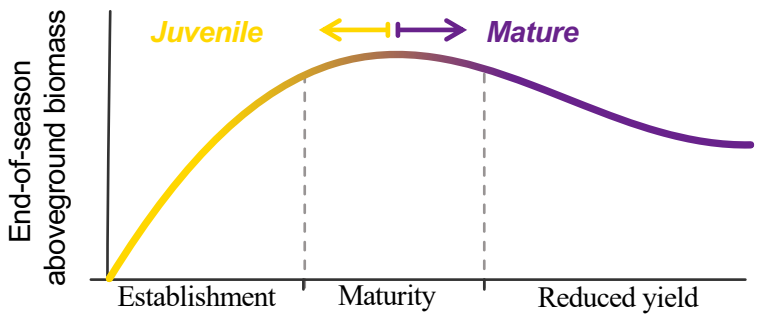

Fig. 1 Long-term dynamics of a perennial grass' end-of-season aboveground biomass.

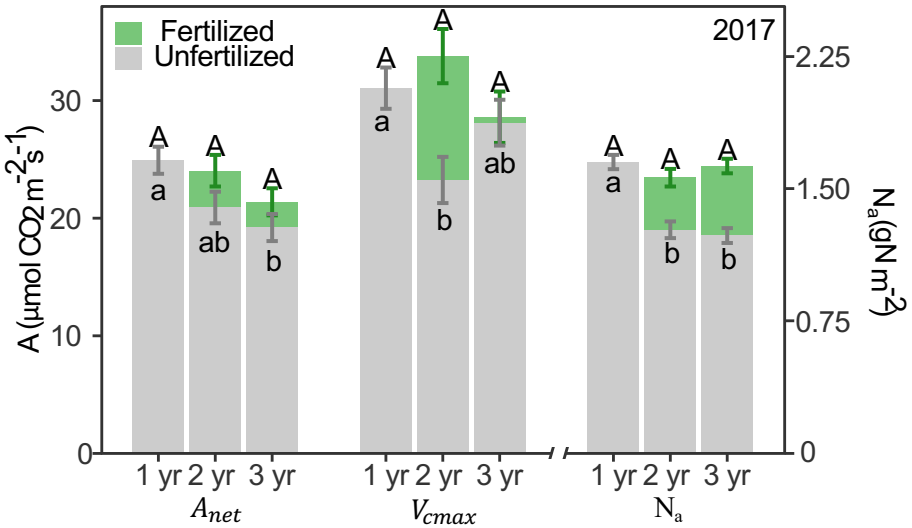

Fig. 2 Nitrogen fertilization effect (green bar) on M×g age-related changes in leaf photosynthesis (i.e., net CO_2 assimilation A_{net} and maximum carboxylation rate of rubisco [V_{cmax}]), and leaf nitrogen content.