CABBI
CENTER FOR ADVANCED BIOENERGY AND BIOPRODUCTS INNOVATION

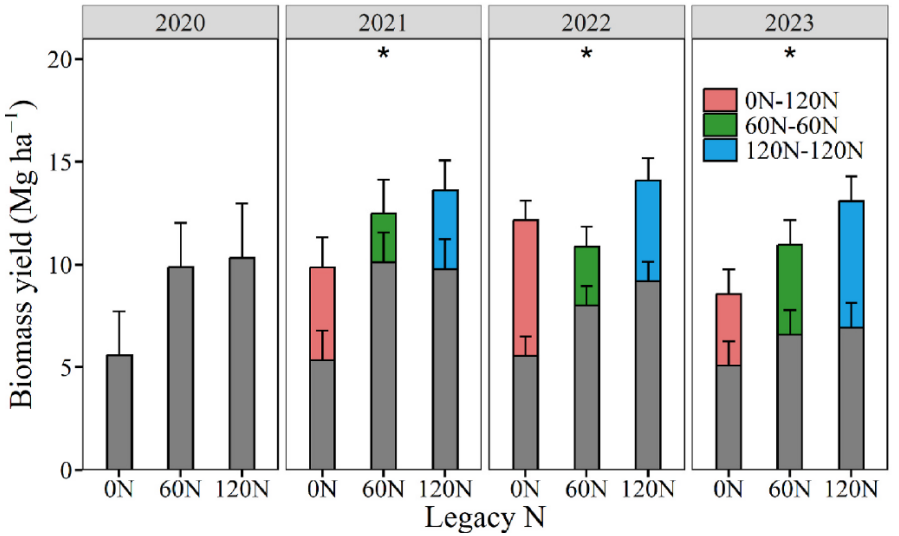
Soil Fertility Management for Sustainable *Miscanthus x giganteus* Production: Increased Tiller Weight from Nitrogen Management Explains Yield Gains in Aged Miscanthus

Background/Objective

Age-related yield decline in *Miscanthus x giganteus* presents a challenge for sustainable biomass production. This study evaluates the impact of nitrogen (N) management and soil fertility on miscanthus yield component traits and productivity.

Approach

Yield dynamics and the relative contributions of tiller weight and density in response to N management were investigated using two trials established in 2008 at the University of Illinois Energy Farm. The Sun Grant trial received 0, 60, and 120 kg N ha^{-1} yr^{-1} until 2015. In 2021, 60 and 120 kg N ha^{-1} yr^{-1} was reintroduced on half of the plots, creating six legacy N - contemporary N treatments (i.e., 0N-120N, 60N-60N, 120N-120N, etc). The previously unfertilized E-Farm trial received 56 kg N ha^{-1} yr^{-1}, forming two treatments: 0N-0N and 0N-56N. Tiller weight and density were measured. Soil N and available phosphorus (P) and potassium (K) were assessed at baseline (2008), and during 2020 (Sun Grant) and 2022 (E-Farm).



Grey bars represent yield under legacy N application rates alone from 2008-2015. Colored bars represent yield response to contemporary N application from 2021-2023. * indicates $p<0.05$.

Results

Fertilized miscanthus produced up to 54% more and >47% heavier tillers in juvenile-to-early maturity. Unfertilized stands lost 35% in tiller weight despite density gains. N withdrawal reduced yield components by 20-40%. 60N-0N and 120N-0N showed >30% more tiller weight than 0N-0N, but tiller density was similar. In aging stands, contemporary N increased tiller weight >30%, leading to >100% yield increase in aging stands. Soil N increased but P (42-53%) and K (21-46%) declined across the treatments after more than 10 years of miscanthus production.

Significance/Impacts

N fertilization improves yields in aging stands by influencing tiller weight. Decline in available P and K may limit performance of aging miscanthus, highlighting the need for macro-nutrient management for long-term productivity.

Namoi et al. 2025. "Soil Fertility Management for Sustainable *Miscanthus x giganteus* Production: Increased Tiller Weight from Nitrogen Management Explains Yield Gains in Aged Miscanthus." *Biomass and Bioenergy*. DOI: 10.1016/j.biombioe.2025.108394.