

Responsiveness of Miscanthus and Switchgrass Yields to Stand Age and Nitrogen Fertilization: A Meta-Regression Analysis

Background/objective

Optimal management of miscanthus and switchgrass for bioenergy requires an understanding of their responsiveness to nitrogen (N) fertilization at different maturity stages across locations and growing conditions. Earlier studies have used field experiments or meta-analysis to probe these interactions with mixed results. We extended these studies by applying a multi-level-mixed-effects (MLME) meta-regression model to conduct more extensive multivariate regression of yield response to N and stand age while controlling for climate, location conditions, and unobserved factors related to study design.

Approach

- ❖ Applied an MLME meta-regression model to 1,403 and 2,811 yield observations for miscanthus and switchgrass, respectively, from experiments conducted between 2002 and 2019 across the U.S. rainfed region.

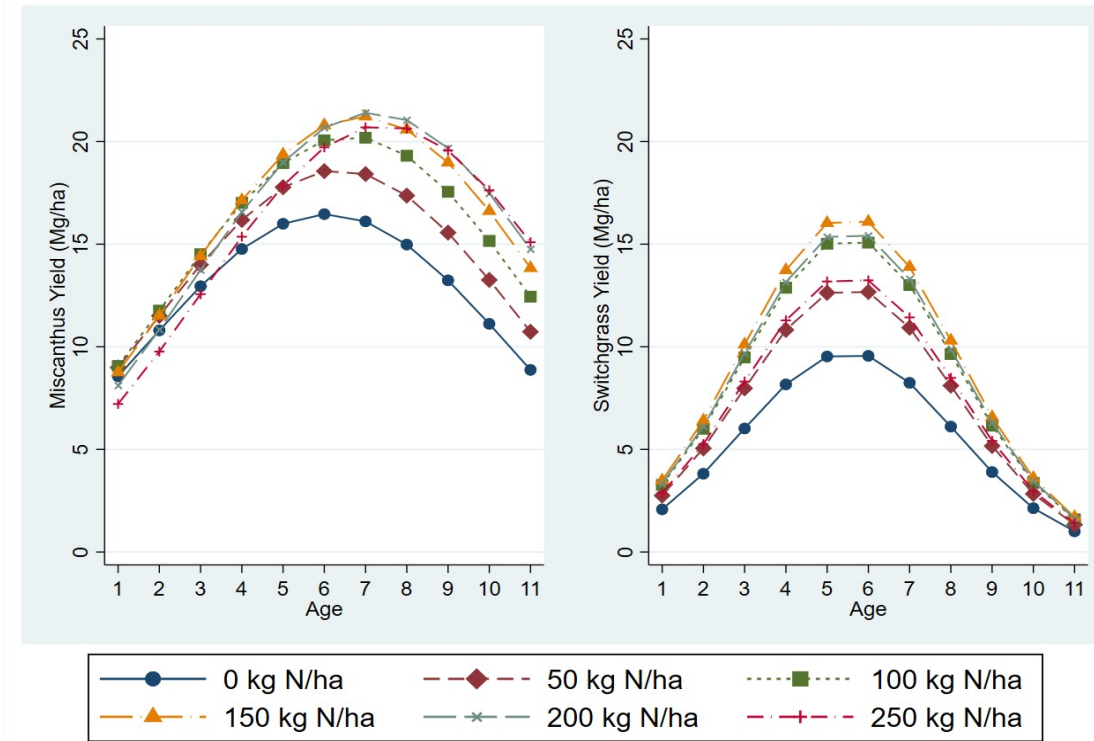
Results

- ❖ An additional year of maturity increased miscanthus and switchgrass yield but at a decreasing rate, with yield peaking in the 7th and 6th years, respectively, for the observed range of applied N rates and stands.
- ❖ Increasing N application results in a small increase in yield but at a declining rate which varies with crop age.
- ❖ N-impact is largest on older miscanthus stands in contrast to middle-aged switchgrass.

Significance

This analysis provides a basis for developing N-application recommendations and optimal rotation age for miscanthus and switchgrass and shows that growth of these energy crops on low-productivity land can equal that on high-productivity land.

Sharma et al. 2022. "Responsiveness of Miscanthus and Switchgrass Yields to Stand Age and Nitrogen Fertilization: A Meta-Regression Analysis." GCB Bioenergy. DOI:10.1111/gcbb.12929.



Mean predicted deterministic yield across maturity stages at various N-application levels for miscanthus (left) and switchgrass (right).