A Novel Estimation of the Nitrogen Demand of Miscanthus x Giganteus

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Introduction and Objective

Estimating the nitrogen (N) demand of Miscanthus x giganteus (miscanthus) is important to calculate N uptake, N storage, and N losses in biomass production systems. We propose an approach to estimate the N demand of miscanthus via the N dilution curve. Our objective is to estimate the parameters of this curve using a biophysical growth equation and theoretical leaf and stem N concentrations.

Method

- N concentration data from multiple miscanthus biomass experiments obtained from a review by Cadoux et al (2012).
- Maximum N concentration was bounded using the maximum N concentration for maize, a C₄ warm season annual grass for which the N dilution curve is well established.
- Minimum N concentration was bounded using the biomass partitioning equation equation with estimates of leaf and stem N concentration.
- A range of stem and leaf N concentrations were calculated based on upper and lower bounds from measured data.
- A model for N dilution was estimated based on so-called critical N concentration for stem and leaf N, and assuming that stem and leaf N concentrations are fixed as biomass accumulates.

Results (cont’d)

- Proposed N curve for miscanthus: $N = 0.027W^{0.30}$

Table 2 Range of N concentrations for plant structures used to determine critical N dilution curve

<table>
<thead>
<tr>
<th>Plant Structure</th>
<th>Range of %N</th>
<th>Avg. %N</th>
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<tbody>
<tr>
<td>Leaf</td>
<td>2 - 5%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Stem</td>
<td>0.4 - 1.1%</td>
<td>0.75%</td>
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</tbody>
</table>

Conclusion

The biomass partitioning equation and N dilution framework can be used to estimate N for W < 20 Mg ha⁻¹ in miscanthus. It also offers a framework to understand the differences between miscanthus and other C₄ grasses like maize and switchgrass.

Future Work

- Proposed dilution model will be tested by sampling stem and leaf N concentrations in N limiting and non-limiting conditions for several biomass levels.
- Validated curve will enable parameterization of miscanthus crop models for N dynamics.
- Validated curve will enable better estimates of N requirements, biomass yield, N losses, and N retention.

References


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