



Long-Term Assessment of *Miscanthus* Productivity and Sustainability (LAMPS)

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Research has consistently shown that *Miscanthus* × *giganteus* (hereafter, *Miscanthus*) is among the most productive biomass crop options for the Midwestern US. Although *Miscanthus* has been shown to be highly productive in its first few growing seasons, some reports have suggested yields may decline over time. Confirming yield decline in a perennial crop such as *Miscanthus* is challenging, because in most studies, stand-age is confounded with growing season, making it impossible to determine if it is age or the growing season conditions causing yield decline. As *Miscanthus* adoption and use continues to increase for fuel, fiber, and bioproducts, it is critical to determine stand longevity, as well as whether yield declines may be overcome through management, such as additional nitrogen fertilizer.

To address this challenge, the biomass team at Iowa State University established the Long-Term Assessment of *Miscanthus* Productivity and Sustainability (LAMPS) project. This project aims to answer the questions industry and producers are asking regarding best management practices for *Miscanthus*.

Materials and Methods

Statistical design. The statistical design of LAMPS is a randomized block design with a split-plot. The whole-plot treatment is planting year, and the sub-plot treatment is N application rate. Whole-plots are 24 m × 61 m and each sub-plot is 12 m × 24 m. Nitrogen application rates (0, 112, 224, 336 and 448 kg ha⁻¹) are repeated once per planting-year and block combination. LAMPS is a chronosequence study with each planting year (2015, 2016, 2017) repeated four times.

Field sites. The LAMPS project is replicated across three research farms: Allee Demonstration Farm in northwest Iowa, Sorenson farm in central Iowa, and Southeast Research and Demonstration Farm (SERF) in southeast Iowa.

Land preparation and herbicide program. *Miscanthus* was planted each spring following conventional tillage appropriate to each farm. Harness[®], Harness[®] XTRA, or Prowl[®] pre-emerge herbicides were applied as close to planting as possible. Approximately one month later, a second application of pre-emerge herbicide, with a differing mode of action than the planting application, was made. If necessary, a broad-leaf herbicide labeled for corn (2,4-D or Laudis[®]) was tank mixed with this pre-emerge application. Additional applications of broad-leaf herbicides were made as necessary to ensure a weed-free establishment during the first two growing seasons. All herbicide applications were made at the rate suggested for corn growing on the soil type found at each respective location. No herbicide was required in the third growing season or beyond.

N application. A liquid solution of urea ammonium nitrate (UAN 28% or 32% depending on the farm) was applied prior to planting using a side-dressing applicator (Figure 1) or was applied over the top using spray equipment. Nitrogen was applied at the appropriate rate each spring prior to, or as close to emergence, as possible.

Plant material and planting. 'Freedom[®]' *Miscanthus* rhizomes were sourced from AGgrow Tech, LLC, and a proprietary rhizome planter (Figure 2) was used to plant each site.



Figure 1. Side-dresser used for applying liquid UAN to *Miscanthus* plots prior to planting.



Figure 2. Proprietary *Miscanthus* rhizome planter.

Data collection. Yield has been continuously measured at all locations since the commencement of LAMPS. Yield is measured by hand-harvesting 1-2 m² of *Miscanthus* from each plot. Material was cut at a height of 6 in. using a hedge trimmer. Biomass was weighed in the field, then dried to determine a bone-dry yield.

Preliminary Results and Discussion

Yields. In 2021, averaged over all sites, there was a significant effect of nitrogen fertilizer ($p < 0.05$), however there was also a significant interaction between N rate and Site ($p < 0.05$). The overall N rate effect was driven by one site: Sorenson (Figure 3). As in previous years, *Miscanthus* grown at Sorenson showed a significant yield and striking morphological response to nitrogen fertilizer (Figure 4, Figure 5).

Planting year also was a significant factor ($p < 0.05$). Averaged over sites and N rate, yields were 24.7, 25.5, and 29.9 Mg ha⁻¹ for 2015, 2016 and 2017 planted *Miscanthus*, respectively (7th, 6th, and 5th growing season, respectively). Although the youngest stand had the highest yield, it is unclear whether yields are declining in the LAMPS *Miscanthus*, as all yields in general were higher than previous years (Figure 4).

Based on results from the past seven years, *Miscanthus* yield response to N rate and aging has been inconsistent. When there has been a response to nitrogen, it has occurred at the lowest N rate, and *Miscanthus* did not benefit from additional nitrogen. Currently, the recommendation is to annually apply between 50–100 kg ha⁻¹ of nitrogen fertilizer. Stand longevity at LAMPS will continue to be monitored.

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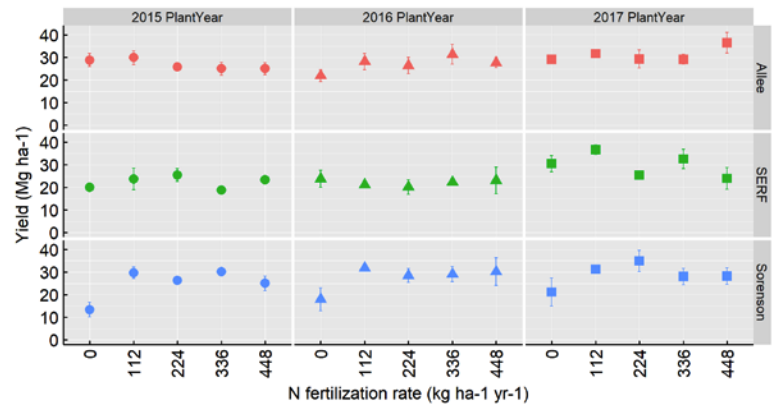


Figure 3. LAMPS *Miscanthus* yields.

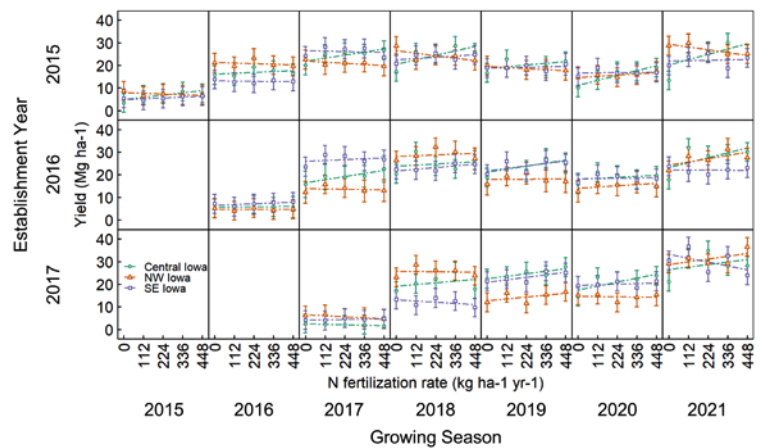


Figure 4. LAMPS Yields 2015-2021.



Figure 5. *Miscanthus* morphological response to N fertilizer at the Sorenson research farm. N-rates pictured left to right: 224, 0, 448 kg N ha⁻¹.