

# Multi-year study of transgenic switchgrass plants in regulation shows improved yield and dependency on expression levels

## Background

- MicroRNAs are regulatory elements that modulate the expression of genes involved in plant growth and development.
- Over-expression of a microRNA (miR156) in switchgrass enabled higher biomass yields and sugar release in the greenhouse. Morphological changes appeared to be driven by relative miR156 transgene levels.

## Approach

- Four promising lines with moderate or low miR156 overexpression from the prior greenhouse study were selected for a field experiment to assess miR156 expression levels and biomass yields over three years. Flowering, disease resistance, cell wall chemistry, and biofuel production were also evaluated.

## Outcome

- The best performing line (a low miR156-expressing line) consistently produced more biomass (25-56%) than the control in all three seasons, which translated to the production of 30% more biofuel per plant in the final season.
- Phenotypes of the other transgenic lines were inconsistent between the greenhouse and the field as well as among different growing seasons. Three lines showed decreased yields. Two lines varied in disease susceptibility.

## Significance

- Transgenics in regulation can result in increased yield. However, results of this study emphasize the importance of performing multi-year field studies for plants with altered regulatory transgenes.
- Transgenic plants with modifications to transcriptional regulators, which impact such a broad range of genes, will likely require more extensive field evaluations than those with single and simple trait gene modifications to evaluate the stability of the desired growth phenotypes.



Photos of the field experiments in the first (2013), second (2014), and third (2015) growing seasons: a) September 27, 2013; b) November 25, 2013; c) August 1, 2014; d) November 12, 2014; e) August 10, 2015; and f) December 8, 2015.