

Toward transgenic sustainable productivity increases in *Miscanthus giganteus*

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Project Goals:

The Renewable Oil Generated with Ultra-productive Energycane (ROGUE) project aims to engineer the two most productive American biofuel crops, energycane and *Miscanthus*, to produce a sustainable supply of biodiesel, biojet fuel and bioproducts. The main objectives of this work are:

- 1) To improve the conversion of sunlight into plant biomass/metabolites through photosynthesis without the need for increased quantities of either water, or fertilizer.
- 2) To transfer ROGUE technologies from the lab bench to crops through an efficient pipeline.

Abstract

Miscanthus × giganteus is a more chilling-tolerant C₄ biomass feedstock in comparison to other phylogenetically-related C₄ crops such as maize, sorghum or sugarcane (1, 2). Photosynthetic activity of C₄ crops is limited by the amount of pyruvate orthophosphate dikinase (PPDK) and rubisco which restrain regenerate of phosphoenolpyruvate (PEP) (1, 3, 4). At the same time, photosynthetic efficiency is shown to improve under fluctuating light when photoprotection response time is accelerated by overexpression of zeaxanthin epoxidase (ZEP), violaxanthin de-epoxidase (VDE) and Photosystem II subunit S (PsbS) (5). We hypothesize that alleviating rate limitation in C₄ photosynthesis by PPDK and accelerating relaxation of photoprotection will significantly raise photosynthetic efficiency in *Miscanthus*. Although *M. × giganteus* fits the characteristics of an ideal bioenergy crop with the added advantage of minimal invasive potential, the propagation of this highly productive feedstock is limited by its triploid genome and the sterility of the plant (6). Traditionally, biolistic transformation of *Miscanthus* uses embryogenic calli induced from immature inflorescences as the main transformation material (7) which can only be collected once a year. In this study, we established a *M. × giganteus* transformation system at the University of Illinois at Urbana-Champaign using microparticle bombardment (8) and demonstrated this transformation method using vectors encoding genes related photoprotection in plants and PPDK, respectively. In order to increase the availability of material for transformation, we are also developing a system to induce embryogenic callus from shoot apices of *M. × giganteus*. With these in place, we hope to obtain a more robust system to study the effect of photosynthetic genes in transgenic *M. × giganteus*.

References

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