Characterizing photosynthetic capacity of sugarcane under fluctuating lights

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Project Goals:
Renewable Oil Generated with Ultra-productive Energycanes—or ROGUE—is engineering the two most productive American crops—energycane and Miscanthus—to produce a sustainable supply of biodiesel, biojet fuel, and bioproducts. Project goals are to:
1) Engineer energycane and Miscanthus to produce an abundance of natural oil that can be converted into biodiesel, biojet fuel, and bioproducts.
2) Improve how plants convert sunlight into plant matter through photosynthesis without more water or fertilizer.

Abstract
C_4 bioenergy crops such as sugarcane and *Miscanthus* have attracted attention as feedstocks for alternative energy sources. The productivity of C_4 bioenergy crops is reliant on the high photosynthetic efficiency of C_4 photosynthesis. However, the rapidly changing light environment within canopies of these C_4 grasses prevents C_4 photosynthesis from operating at its highest efficiency. How fluctuating light effects C_4 bioenergy crop productivity is not fully understood. We hypothesize that the metabolite pools of C_4 photosynthesis buffer photosynthetic fluctuations during fluctuating light conditions in C_4 leaves. The previous modeling suggested the metabolite buffering capacity of C_4 photosynthesis could be capable of sustaining high rates of photosynthesis for up to 15s following a high light to low light transition or facilitate a more rapid return to high rates of photosynthesis following a low to high light transition. Thus we hypothesize that increased chloroplast volume may increase this metabolite buffering capacity and thus enhance the performance of photosynthesis in fluctuating light. We tested leaf gas exchange of transgenic sugarcanes that have increased chloroplast volume due to the insertion of an FtsZ RNAi construct to determine whether increased chloroplast volume could enhance the performance of photosynthesis in fluctuating lights. Our preliminary results indicate that the transgenic sugarcane more rapidly recovers high photosynthetic rates during low to high light transition when compared to wild-type sugarcane. Simulating dynamic light conditions can provide insight into the interaction between C_4 photosynthesis and dynamic light.

References

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