Secondary metabolite profile of sugarcane leaves submitted to water stress

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INTRODUCTION

Sugarcane is an important commercial crop cultivated in tropical and sub-tropical regions mainly for its sucrose content, the raw material for sugar and ethanol industries. Brazil is the largest producer of ethanol from sugarcane in the world and occupies the leadership in technology for its production. In Brazil, sugarcane cultivation is expanding to central and northeast regions, where water availability is scarce. Sugarcane production is negatively influenced by a vast number of environmental factors that affect growth, metabolism and yield. Among them, drought is the strongest and has the most severe limitation on sugarcane yield [1]. Water stress induces various biochemical and physiological responses in plants, such as accumulation of solutes including sugars, polyols, betaines and amino acids. The capacity of monitoring a set of metabolites could largely improve the understanding of mechanisms involved in plant responses to drought stress. Besides, differences in metabolite content can also represent good predictors for drought tolerant phenotypes both for variety screening and plant breeding programs.

OBJECTIVES

We aimed to identify the metabolite profile of sugarcane leaves submitted to water stress and also identify metabolites differentially abundant among our experimental conditions.

MATERIAL AND METHODS

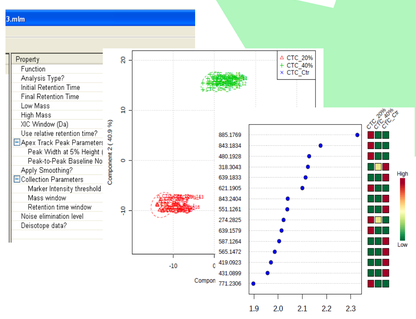
Here we report the analysis of sugarcane leaf (+1), from a five month-old drought tolerant variety (CTC 15), submitted to normal water supply, moderate stress (40% field capacity) and severe stress (20% field capacity).

Physiological parameters – *IRGA* (Infrared gas analyzer)

Metabolite extraction (De-Vos et al., 2007)

UPLC-ESI-Q-TOF-MS

Sugarcane variety tolerant to drought



Data processing (MarkerLynx) and statistical analysis (MetaboAnalyst)

RESULTS

The photosynthetic performance of the sugarcane variety tolerant to drought (CTC15) can be observed in figure 1. As expected tolerant plants showed higher photosynthetic rate.

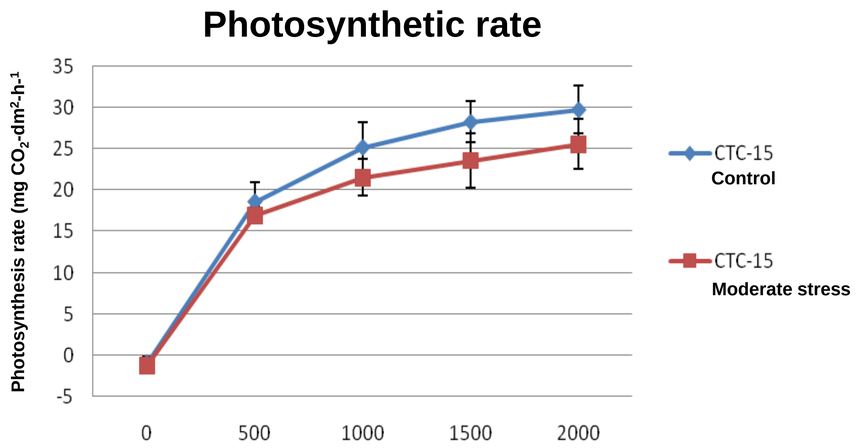


Figure 2: Photosynthetic rate of the sugarcane drought tolerant variety CTC15: Control (100% field capacity) and Moderate stress (40% field capacity).

A multivariate statistical analysis was performed by Partial Least Square Discrimination (PLS-DA) (Figure 2A). PLS-DA model demonstrated a clear separation between samples (Q2>0.9), ensured a reliable analysis. Metabolites were ranked according to their contribution to the prediction of drought tolerance, by the “variable importance in the projection” (VIP) (Figure 2B) .

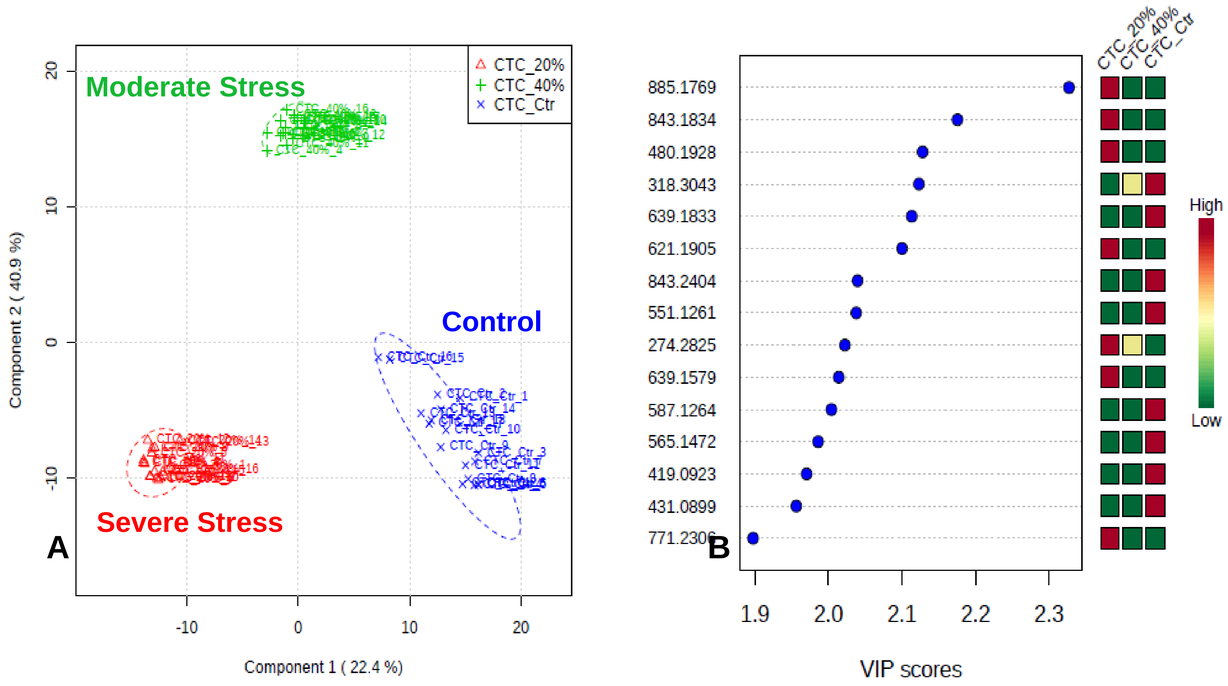


Figure 2: Multivariate analysis of sugarcane leaves submitted to drought stress: control, moderate stress and severe stress. 1 A- PLS-DA of the metabolite profile. 1 B- “ VIP” indicating the metabolites differentially abundant among samples.

We were able to discriminate samples and observe leaf metabolite changes in response to water stress. These results provide important insights into sugarcane responses to water deficit. The next steps aim to identify differentially abundant metabolites by MS/MS fragmentation.

REFERENCES

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