CIRCADIAN RHYTHMS IN C4 GRASSES

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FAPESP Process 2011/00818-8 | Term: Jun 2011 to Nov 2015 | Young Investigator

Figure 1. Sugarcane field in UFSCar (Araras – SP) in different times of the day: at dawn, in the middle of the day, at the end of the day, and at night. The circadian clock allows the plant to anticipate rhythmic changes, such as in light, temperature , and humidity

Plants have internal timekeeping mechanisms that increase their productivity in a rhythmic world. These mechanisms, called the circadian clock, allow plants to anticipate rhythmic changes in the environment, such as light and dark or warm and cold; to detect seasonal changes; and to organize their metabolism during a single day. One of the major challenges in the area is to fully understand how the circadian clock enhances the plant productivity. Arabidopsis thaliana with changes in their circadian clock accumulate less biomass, have less chlorophyll, and have reduced water use efficiency. Our group is interested in the role of the circadian clock in C4 grasses, in particular, sugarcane.

SUMMARY OF RESULTS TO DATE AND PERSPECTIVES

Using oligoarrays, we have estimated that a third of transcripts from sugarcane leaves are rhythmic in constant environmental conditions. These transcripts are regulated by the circadian clock. This proportion is unusually high. Experiments with other species usually estimate 10% to 20% of circadian clock-controlled transcripts. This suggests that the sugarcane circadian clock is particularly important to this crop, which was bred for high sucrose and high productivity. Transcripts associated with many physiological processes were regulated by the circadian clock in sugarcane leaves, including photosynthesis, sucrose and starch synthesis and degradation, DNA and RNA metabolism, and hormone signalling.

We are now investigating rhythms in plants growing inside in a sugarcane field. This experiment will identify transcripts that are rhythmic driven by the circadian clock and other environmental rhythms. Different organs will be harvested: a source organ (leaf +1), a sink organ specialized in cell division and expansion (internodes 1 and 2), and a sink organ specialized in sucrose accumulation (internode 5).

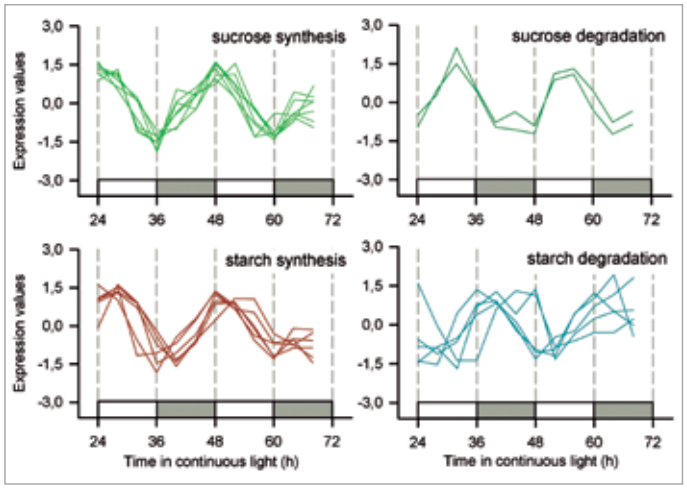

Figure 2. Transcripts associated with sucrose and starch synthesis and degradation are regulated by the sugarcane leaf circadian clock. The transcripts are co-regulated in order to organize different processes in time. During the course of 24 hs, sucrose starts to be synthetized at dawn, followed closed by starch synthesis. Towards the end of the day, sucrose starts to be degraded, followed by starch degradation during the night.

MAIN PUBLICATIONS

Hotta CT, Nishiyama-Junior MY, Souza GM. 2013. Circadian rhythms of sense and antisense transcription in sugarcane, a highly polyploid crop. *Plos One.* **8**: e71847.

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