CODING_ Circadian clock and photoperiodism in marine angiosperms(seagrasses): evolution and ecological significance

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Abstract

The rhythmic alternation of light and night over 24-h caused by the Earth's rotation is the primary driver for the emergence and evolution of an endogenous timekeeper (i.e. circadian clock) that enables organisms to measure time without environmental cues. Circadian clock systems are present in almost all living organisms, providing an adaptative advantage by allowing early responses to daily changes in external environment. The biological response to changes during daylight is defined as photoperiodism. It allows organisms to adapt to predictable changes in their environment. In plants, photoperiodic sensing is mediated by photoreceptors proteins (e.g., phytochromes, cryptochromes and other blue receptors), which perceive changes in some specific bands of the light spectra and transmit this information to the circadian clock.

Photoperiodism and circadian clock regulation produce daily rhythms in metabolism and promote seasonal environmental responses through gene expression regulation and post-transcriptional mRNA modifications that include alternative splicing (AS), alternative polyadenylation (APA) and post-transcriptional RNA modifications (e.g., methylation).

Populations of plants across a wide range of geographical scales and selected crop accessions showed differences in genetic polymorphisms (SNPs) associated with genes involved in the photoperiodic control of flowering time. In marine species (seagrasses), how epigenetic, transcriptional, and genetic polymorphisms affect photoperiodism is still largely unknown.

Taking advantage of new molecular genetics and genomics resources available for seagrasses, together with the progress of bioinformatics approaches, in this PhD project we will characterize the whole molecular toolkits of the circadian and photoperiodic system of different seagrasses species, and we will compare this data with those available for other photosynthetic species (both, plants and algae) to improve our understanding of adaptations in this peculiar group of plants. We will explore different layers of the circadian regulation of gene expression, for example, identifying diel and circadian-regulated genes, splicing events and mapping changes in methylation profiles of mRNA in different seagrass species. In addition, we will assess the existence of polymorphisms (SNPs) related to photoperiodism in populations distributed across geographical scales.

Results will highlight target genes and gene networks that contributed adaptation of these plants to marine lifestyle and their potential and limitation in acclimating to global warming. **Keywords**: circadian clock, photoperiodism, (epi)-transcriptomic, evolutionary biology, bioinformatics, chronobiology.