Regulation of the growth hormone networks by the endogenous circadian clock and sugar signals

Zhi-Yong Wang[1], Eunkyoo Oh[1], Jia-Ying Zhu[1], and Zhenzhen Zhang[1]
[1]Department of Plant Biology, Carnegie Institution for Science, [2]College of Life Science, Hebei Normal University, Shijiazhuang

While proper growth responses are required to optimize light exposure and photosynthetic efficiency, plant growth also requires photosynthates as energy source and call wall building materials. Therefore, hormone programs need to respond to not only environmental signals such as light and temperature, but also endogenous cues such as nutrient availability and circadian rhythms. Shoot cell elongation is synergistically promoted by growth hormones brassinosteroid (BR), auxin, and gibberellin (GA), and inhibited by light signals, through cooperative interactions among the BR-activated BZR1 family transcription factors, the auxin response factors (ARF), and the phytochrome-interacting factors (PIFs), as well as their antagonism by the GA-sensitive DELLA proteins (BAP/D module). The BAP/D module elegantly explains how these hormonal and light signals co-regulate shoot cell elongation and seedling photomorphogenesis, and how additional cues such as the circadian clock and temperature control hormone sensitivities by altering PIF levels. Here we report that (1) the circadian clock gate plant growth through direct interaction between the clock component TOC1 and the PIF4 transcription factor, to provide optimal thermo-responsive growth at the time of natural heat stresses, (2) sugar signalling through the Target Of Rapamycin (TOR) pathway controls the accumulation of BZR1 to balance growth with photosynthate availability. Our studies further expand our view of the hormone interaction network that control plant growth.