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Editorial: Light, clock, flowering, and hormone pathways in attaining abiotic stress tolerance

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Editorial on the Research Topic

Light, clock, flowering, and hormone pathways in attaining abiotic stress tolerance

Improving yield of food crops is most challenging since yield is the most dynamic trait influenced by various environmental, genetic factors, also due to decrease of yield is pervasive by continuously deteriorating environment in the present-day scenario (Dwivedi et al., 2013). Abiotic and biotic stresses impose great impediments on plant growth and crop productivity (Kumar, 2020). Hence, there has been continuous researches to find various ways not only to combat biotic and abiotic stress, to generate stress resistant plants and crops, but also to attain deeper understanding of different pathways to gain stress resistance and improve crop productivity. Light, and hormone pathways have long been proved to have control over plant yield and stress tolerance (Bechtold and Field, 2018). However, plant circadian clock has also recently been observed to have involvement in these mechanisms (Sharma et al., 2022). Hence, in depth understanding and utilization of recent advances on light, circadian clock and hormone pathways may unlock new roadways to develop strategies for generating abiotic, biotic stress tolerant plants with sustainable or higher yield.

Recent advances such as Phytochrome B discovered as the thermos-sensor in addition to its primary role as red light photoreceptor (Chen et al., 2022), Phytochrome interacting factors (PIF) being the master downstream connectors to thermo-morphogenesis, skoto-morphogenesis, abiotic stress tolerance and flowering pathways (de Lucas and Prat, 2014), discovery of new UV-B photoreceptor UVR8 (Liang et al., 2019), necessity of light for proper root growth (Villacampa et al., 2022), revelation of phytochrome nuclear bodies as active sites of chromatin remodeling and pre-mRNA processing (Cheng et al., 2021), involvement of Phytochrome B in many pathways including abiotic & biotic stresses, herbicide tolerance (Dalazen and Merotto Jr., 2016), flooding tolerance (Courbier and Pierik, 2019), stem mechanical strength (Luo et al., 2022), gravitropism (Xie et al., 2019) are crucial areas to investigate for improving yield. Updates on circadian clock signaling such as evening complex (Ezer et al., 2017), differential regulation of florigen for different photoperiods (Tylewicz et al., 2015), variation of clock organization in different plant systems (Patnaik et al., 2022) are important for designing new stress tolerant strategies in plants. Discovery of noble growth regulators such as strigolactones (Bhatla et al., 2018), phytomelatonin (Moustafa-Farag et al., 2020), and new signaling molecules like nitric oxide (Hancock and Neill, 2019) have opened multiple doors to investigate ways to improve yield of crop plants.

The study by Cortleven et al. shows how alterations in photoperiod induces a stress similar to pathogen stress in plants. They show that photoperiod stress induces transcriptional changes in jasmonic acid and salicylic acid signaling and their synthesis, which are generally observed after pathogen infection. The open question on how pre-treatment on plants having photoperiod stress increasepathogen resistance should be investigated in further experiments. Photoperiod stress enhances pathogen defence response could be extended for deeper understanding following to facts shown by Cortleven et al..

A recent update on results of time lag between temperature and light cycles and their effects on the circadian clock and can be predicted by its entrainment properties is shown by Masuda et al.. The authors use transgenic *Lectuca sativa* seedlings with a luciferase reporter system to demonstrate this with a phase oscillator model in simulation. Based on their predictions, it is now possible to control growth of the plant by adjusting the time lag. Projected leaf area could be used to evaluate the effect of time lag on both growth and circadian rhythm.

As Zhao et al. enclose here an updated research evidence on how light plays a role in maize mesocotyl and coleoptile elongation and germination, as the mesocotyl and coleoptile are considered as two major traits in maize. The authors show that dynamics of different phytohormones accumulation and lignin deposition are closely related during the light-mediated de-etiolation process. Authors also perform transcriptional analysis and establish gene co-expression network, which reveals 49 hub genes in one and 19 hub genes in two modules in this light-mediated process. They lay a robust theoretical foundation of the molecular network underlying the inhibition of maize plasticity elongation by MES and COL in red, blue, and white light stimulations, further functional analysis of promising target and gene will now be easier while extending the research in gene editing and breeding applications.

Patnaik et al. investigate the role of GIGENTEA in response to *Fusarium oxysporum* infection is at molecular level by comparing in different mutant backgrounds of *Arabidopsis thaliana*. The result of this study shows that jasmonic acid pathway is up-regulated post infection during wilt disease caused due to *F.oxysporum*. The confirmatory evidence of Patnaik et al. on involvement of GIGENTEA, component of circadian clock, in biotic stress tolerance has built a strong fundamental base to perform further experiments of control of diseases in crops by controlling clock in crop plants.

Importance of N6-methylation of messenger RNA for the photomorphogenic responses is shown by Zhang et al.. The authors study profiles the transcriptome of William 82 cultivar of soybean in response to light. The authors show that light signaling pathway genes such as GmSPA1, GmPRR5 and GmIC6 undergo methylation in response to light. They also claim that differential m6A peaks are involved in photosynthesis and circadian rhythm pathways. This comprehensive map of light-regulated m6A modification in soybean by Zhang et al. lays a solid foundation for further research into the functional role of light on RNA m6A modification in soybean.

Author contributions

The author confirms being the sole contributor of this work and approved it for publication.

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Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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