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A balanced mechanism between plant growth and stress response

Zi-Bo Lin [a], Yan-Xiang Zhao [b], Wen-Chao Yang [a,*]

[a] National Key Laboratory of Green Pesticide, Central China Normal University, Wuhan, 430079, PR China

[b] Department of Applied Biology and Chemical Technology, State Key Laboratory of Chirosciences, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China

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ABSTRACT

We intended to highlight the interesting findings that three leucine-rich repeat receptor kinases function as receptors for sulfated plant peptide hormones, which could mediate switching between plant growth and stress tolerance. Thereafter, we proposed the potential of developing chemical regulators for promoting plant growth when they are suffering from environmental stresses.

Green plants are the indispensable resource for sustaining ecological balance, promoting circulation, and serving as direct biological food sources.[1] As is well known, plants are sessile organisms and have to endure different kinds of stress that could seriously hamper their viability.[2] Thus, it is critically important for plants to decide whether to grow or to divert energy to stress responses to survive in a complicated environment. Yet the molecular mechanism of how plants manage this physiological trade-off remains a mystery.

A paper published recently by Yoshikatsu Matsubayashi et al. in *Science* explored the cell-to-cell communication pathways that decide the trade-off between plant growth and stress tolerance, and reported novel findings on how plants survive under diverse environmental stresses (Fig. 1).[3] Specifically, the authors identified that three leucine-rich repeat receptor kinases (LRR-RKs) work as direct ligand-perceiving receptors for plant peptides containing tyrosine sulfation (PSYs)-family peptides. Moreover, they found that the particular receptor-peptide interaction could mediate the switching between stress tolerance and plant growth.

LRR-RKs constitute a large family of receptor kinases that play vital roles in plant growth. Many LRR-RKs activate downstream signal transduction pathways in a ligand-binding-dependent manner.[4] PSY hormones generated from sequential post transitional and proteolytic modifications regulate diverse biological functions in plants such as promoting root growth and increasing cell size but their cognate receptors are unknown.[5] Through exhaustive search using multiple techniques such as photolabeling and radiolabeling, Matsubayashi et al. identified three LRR-RKs (named as PSYR1, PSYR2, PSYR3) as the perceiving receptors of PSY peptides.[3] The authors further discovered that the PSY peptides regulate the stress response through an unexpected ligand-deprivation-dependent activation system because the PSY-PSYR interaction blocks downstream signaling while PSYRs only genes that are responsible for activating stress response and impedinng the plant growth in the absence of PSY peptides. Moreover, they demonstrated that deficiency of PSYRs impaired tolerance to various environmental stresses, thus further validating PSYR as essential for plant stress response. They also observed that damage to plant cells led to a reduction of the extracellular PSY concentration to activate PSTY-mediated stress response. Taken together, stress-induced reduction in PSY level could activate the PSYR signaling network that enables plants to mount proper

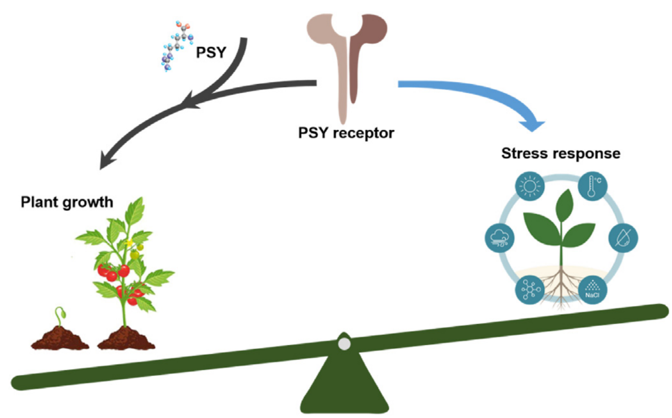

Fig. 1. Schematic mechanism of PSY-PSYR interaction balancing the stress tolerance and plant growth.

* Corresponding author.
E-mail address: tomyang@ccnu.edu.cn (W.-C. Yang).

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stress responses and keep plant growth.

This study sheds light on the novel molecular mechanism employed by the PSY-PSYR interaction to balance plant growth and stress tolerance. The unique ligand-deprivation-dependent activation system provides ample opportunities for development of chemical regulators to enhance the PSY-PSYR interaction. Chemical biologists could design small organic molecules or stapled peptides by mimicking the chemical structure of PSY to target particular PSYR. Hopefully, the well-designed chemical regulators will compensate the PSY-PSYR interaction, promoting the balance movement to the direction of plant growth.

Declaration of competing interest

The authors declare no competing financial interest.

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