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Plant growth

Receptor role in protection unmasked

How a plant hormone receptor helps a vital process necessary for maintaining healthy plant growth is finally understood

Hormones play a crucial role in regulating the growth and development of plants. One group, called gibberellins (GAs), is involved in seed germination and promoting new cells in stems, leaves and flowers. Only in the past decade have researchers begun to uncover the precise mechanisms involved in GA signalling in plants, because very little has been known about the structure and behaviour of GA receptors.

In 2008, researchers at NAIST, working with scientists in the United States, established the first structural model of a gibberellin receptor called GID1A, found in thale cress plants (*Arabidopsis thaliana*), and with that revealed a key process involved in protecting healthy plant development[1].

There are 136 known GAs, but only a few of them function as hormones; those that do are known as bioactive GAs. Without the presence of bioactive GAs, plants are stunted and dwarfed; but if too much is present, the cells in the plant stems are elongated – producing plants that are tall and often infertile.

Toshio Hakoshima and NAIST co-workers conducted a series of crystallographic and biochemical studies of GID1A and observed how it is activated by binding to a bioactive GA. Their aim was to verify how GA and GID1A both bind to, and trigger, the degradation of a negative transcriptional regulator of GAs called GID1-DELLA. DELLA proteins can disrupt the regulation of GA, causing significant damage to plant growth.

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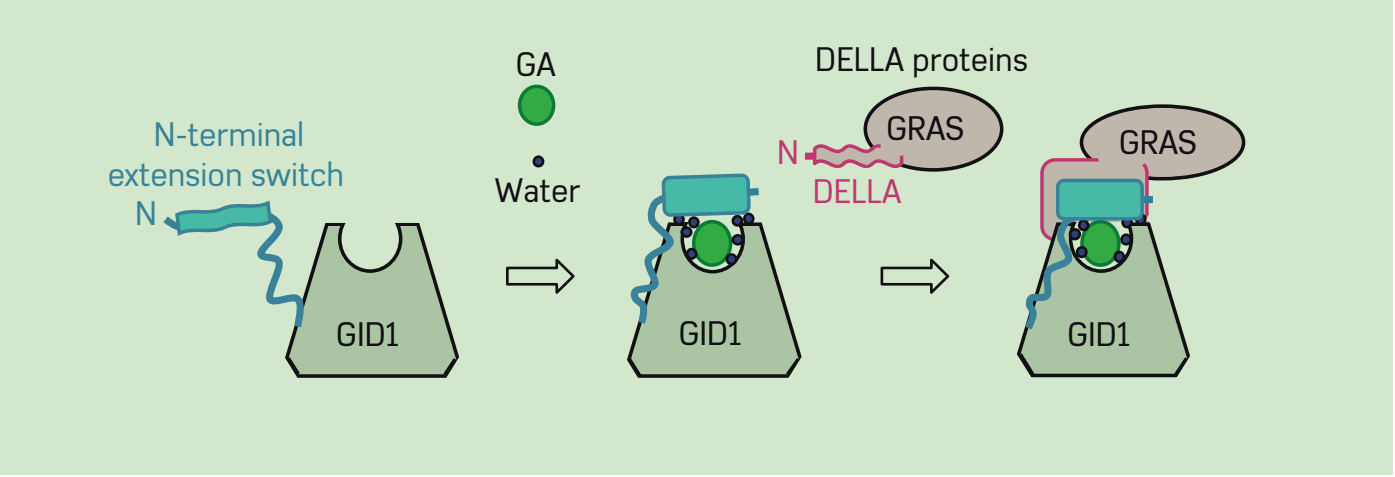
They found that GID1A has a compact form with a so-called 'N-terminal extension', as well as a pocket for GA incorporated into its structure (see figure). The N-terminal senses GA and, once GA binds to GID1A, folds back on itself to cover the GA pocket. In this way, the N-terminal acts as a shield to protect GA.

Following the initial binding, GA activates GID1A, triggering conformational change – an alteration in the shape of the macromolecule – in the folded N-terminal extension, creating a binding surface for the GID1-DELLA protein. Once GID1-DELLA is bound to GID1A, the receptor sends out an explicit signal, targeting GID1-DELLA for degradation by other proteins.

Through this work, Hakoshima and his team deepened understanding of how cellular functions can be regulated by signalling from hormones and their receptor molecules. Their findings could help influence crop-selection and the manipulation of plant growth. For example, it may be possible to develop derivatives of GAs to use as growth regulators in some crop plants.

Reference

1. Murase, K., Hirano, Y., Sun, T-P. & Hakoshima, T. Gibberellin-induced DELLA recognition by the gibberellins receptor GID1. *Nature* **456,** 459–464 (2008).



The structural mechanism by which receptor GID1A binds with gibberellin hormones (GAs) and subsequently binds to and targets GID1-DELLA proteins for degradation. The process helps protect correct plant growth and development.

More information about the group's research can be found at the Structural Biology Laboratory webpage:
http://bsw3.naist.jp/eng/courses/courses306.html