Quick guide

Gibberellins

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How is that said? *jib'er el'ins* (or GAs).

Not to be confused with… the metal gallium (Ga), the state Georgia, or gibberish (this last one really hurts).

What are they? The gibberellins make up a family of small organic compounds derived from a common 20-carbon precursor. They regulate growth and development in plants and their chemical structure superficially resembles that of steroid hormones. So far, more than 100 gibberellins have been identified. Fortunately, any one plant species produces only a few of the known gibberellins. Furthermore, only one or two of those gibberellins will typically be biologically active.

Where did the name come from? Gibberellins were first identified in the 1930s by Japanese researchers studying the fungus *Gibberella fujikuroi*, a rice pathogen. Gibberellin was the name given to the active compound isolated from the fungus that promotes aberrant growth in rice. It later turned out that gibberellins are also synthesized by plants … but by then the name had stuck.

What do they do? Gibberellins are endogenous growth regulators. Their ability to promote seed germination, shoot elongation and flowering is well characterized in many plant species. In plants with strong defects in gibberellin biosynthesis, growth and development are profoundly affected — the list of specific phenotypic defects goes on and on.

How are they made? Thanks to some great biochemistry, the gibberellin biosynthetic pathway in several higher plants has been known for some time. Many of the genes encoding gibberellin biosynthetic enzymes have been cloned recently, as well as genes encoding enzymes that inactivate gibberellin. The gene products include diterpene cyclases, cytochrome P450-dependent monooxygenases and 2-oxoglutarate-dependent dioxygenases. Transcription of genes encoding enzymes in the latter part of the gibberellin biosynthetic pathway is subject to negative feedback regulation by gibberellins. Conversely, transcription of genes encoding enzymes that deactivate gibberellins is promoted by gibberellins.

How do they work? Plant development is exquisitely responsive to environmental stimuli, and gibberellins play an important part in that developmental plasticity. Recent work has highlighted the role of up-regulation of gibberellin biosynthesis in the germination of

yet known exactly how gibberellins regulate plant development but they seem to mediate at least some of their effects at the level of transcriptional regulation, as genes that exhibit gibberellin-dependent transcription continue to be identified.

What about a receptor? There's nothing definite yet. Work with germinating cereal grains indicates that gibberellins are detected at the plasma membrane of plant cells. There are two polypeptides from plasma membrane preparations of several plant species that are photoaffinity labelled by gibberellin, but their identity is unknown.

Who are their known associates? Work with germinating cereal grains has both identified a Myb-like transcription factor that mediates gibberellin-dependent regulation, and provided evidence for the involvement of an assortment of signaling components and mechanisms (G proteins, cGMP, Ca^{2+}, phosphorylation, and so on). In *Arabidopsis*, the *GAI* and *RGA* genes encode highly similar proteins that are thought to have overlapping roles as negative regulators of gibberellin signal transduction. They are members of a class of putative transcription factors, the GRAS family, which is unique to plants. In *Arabidopsis*, the *SPY* gene encodes a putative *O*-GlcNAc transferase that is needed for negative regulation of gibberellin signal transduction (*O*-GlcNAc modification of proteins is emerging as a mechanism of signal transduction).

Do they have commercial potential? It seems so. It has long been noted that the phenotype of the high-yielding wheat varieties that contributed to the 'green revolution' is similar to that of the *gai* mutant of *Arabidopsis*. Cloning of the wild-type wheat genes corresponding to the *gai* mutant loci revealed that they are.

whether introduction of a dominant negative allele (one that eliminates the activity of the wild-type gene product) of *Arabidopsis GAI* can generate a high-yielding rice variety analogous to those in wheat. If so, it would be no mean feat for a gene from such a nondescript little weed.

Where can I find out more?

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