Towards resolution of a paradox in plant G-protein signaling

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摘要	G-proteins are molecular on–off switches that are involved in transmitting a variety of extracellular signals to their intracellular targets. In animal and yeast systems, the switch property is encoded through nucleotides: a GDP-bound state is the "off-state" and the GTP-bound state is the "on-state". The G-protein cycle consists of the switch turning on through nucleotide exchange facilitated by a G-protein coupled receptor and the switch turning off through hydrolysis of GTP back to GDP, facilitated by a protein designated REGULATOR OF G SIGNALING 1 (RGS). In plants, G-protein signaling dramatically differs from that in animals and yeast. Despite stringent conservation of the nucleotide binding and catalytic structures over the 1.6 billion years that separate the evolution of plants and animals, genetic and biochemical data indicate that nucleotide exchange is less critical for this switch to operate in plants. Also, the loss of the single RGS protein in Arabidopsis (Arabidopsis thaliana) confers unexpectedly weaker phenotypes consistent with a diminished role for the G cycle, at least under static conditions. However, under dynamic conditions, genetic ablation of RGS in Arabidopsis results in a strong phenotype. We explore explanations to this conundrum by formulating a mathematical model that takes into account the accruing evidence for the indispensable role of phosphorylation in G-protein signaling in plants and that the G-protein cycle is needed to process dynamic signal inputs. We speculate that the plant G-protein cycle and its attendant components evolved to process dynamic signals through signaling modulation rather than through on–off, switch-like regulation of signaling. This so-called change detection may impart greater fitness for plants due to their sessility in a dynamic light, temperature, and pest environment.
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