FAST BREAKING PAPERS - 2008

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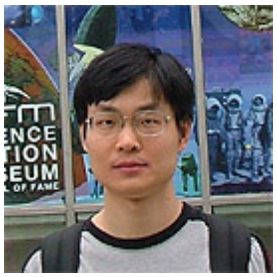
Suhua Feng & Xing Wang Deng talk with *ScienceWatch.com* and answer a few questions about this month's Fast Breaking Paper in the field of Plant & Animal Science.



Article Title: Coordinated regulation of Arabidopsis thaliana development by light and gibberellins
Authors: Feng, SH;Martinez, C;Gusmaroli, G;Wang, Y;Zhou, JL;Wang, F;Chen, LY;Yu, L;Iglesias-Pedraz, JM;Kircher, S;Schafer, E;Fu, XD;Fan, LM;Deng, XW
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(addresses have been truncated)

SW: Why do you think your paper is highly cited?

Light and gibberellins (GA) are two important factors regulating multiple aspects of plant development. It was previously known that both pathways have crosstalk with each other; however, molecular mechanistic insight was lacking. The study in our paper defines a novel and important connection between light and GA signaling. Therefore, it is of interest to both light and hormone signaling fields.

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

This paper describes a new discovery. Briefly, in the absence of GA, GA pathway negative regulator DELLA proteins bind to PIF3, a bHLH-type transcription factor, to sequester PIF3 from its target gene promoters. While in the presence of GA, GA receptors GID1 proteins bind DELLA proteins to target them for proteasome-mediated proteolysis, and free PIF3 can then bind to promoters.

Interestingly, PIF3 is a known phytochrome-interacting protein, which plays important roles in light-induced seedling development, especially in controlling hypocotyl length, an important characteristic of photomorphogenesis. Therefore, our results reveal a signaling cascade, which involves multiple pairs of protein-protein interaction and contributes to the concerted regulation of *Arabidopsis* hypocotyl growth by light and gibberellins.

Coauthor

SW: Would you summarize the significance of your paper in layman's terms?

Together with a paper by Salomé Prat's group at the Centro Nacional de Biotecnología in Madrid, entitled "A molecular framework for light

and gibberellin control of cell elongation," from the same issue of *Nature* 451: 480-84, January 24, 2008, we provided a most reasonable and intriguing model in which DELLA proteins, which are nuclear repressors of plant GA responses, negatively control the activity of a number of transcription factors by binding with a conserved basic helix–loop–helix (bHLH) DNA-interacting domain. Therefore, the binding of these transcription factors to DELLA proteins and to gene promoters would be mutually exclusive. This would enable DELLA proteins to regulate a large number of genes, which is consistent with their critical role in GA-induced gene expression.

SW: How did you become involved in this research, and were there any problems along the way?

The major focus of the laboratory is on light-induced plant growth. Typical *Arabidopsis* seedlings grown in light have short hypocotyl and opened cotyledons; whereas dark-grown seedlings have long hypocotyl and closed cotyledons. This phenomenon has been fascinating biologists for centuries. It has also been known, for a long time, that a plant hormone, gibberellin (GA), is able to induce elongation of hypocotyl, much like the opposite of light effect.

One interesting similarity between light and GA signaling is that both pathways contain proteins that either regulate or are targets of ubiquitin/proteasome-mediated proteolysis. This prompted us to focus on the DELLA family of GA signaling repressors, which are known substrates of the ubiquitin/proteasome system. That is how this project got started. This has been a huge effort, and many difficulties had to be overcome along the way. One example, we encountered a lot of problems when trying to produce specific antibodies against all the DELLA proteins. We ended up using tagged transgenic lines in most of our experiments.

Where do you see your research leading in the future?

Future research may substantiate whether this is the main mechanism how DELLA proteins function or is it only one of the many ways in which they work. Follow-up could place emphasis on identifying more transcription factors that are targeted by DELLA proteins, further dissecting the interaction between DELLA proteins and transcription factors, and thereby characterizing the genes regulated by DELLA-controlled transcription factors.

Do you foresee any social or political implications for your research?

Such implications are not evident at this time. Nonetheless, it is worthwhile to mention that all food on earth derives from plants and that wheat mutants of DELLA, which are shorter, more resistant to wind and rain damage and have increased grain yield, contributed to the so-called "Green Revolution." Therefore, understanding the precise mode of action of DELLA proteins might have social benefits in the long run, especially given the increasing food shortage problems around the world.

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Keywords: light and gibberellins, crosstalk, ubiquitin/proteasome-mediated proteolysis, phytochrome-interacting protein, light-induced seedling development, arabidopsis hypocotyl growth, photomorphogenesis, basic helix–loop–helix dna-interacting domain, light-induced plant growth, cotyledons, della-controlled transcription factors, green revolution.

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