

Editorial Feature: Meet the *PCP* Editor—Keiji Nakajima

Keiji Nakajima obtained a doctoral degree at the Graduate School of Agriculture in Kyoto University, Japan, researching the enzymology, molecular biology and X-ray crystallography of alkaloid biosynthetic enzymes in medicinal plants. He became a faculty member of the newly established Nara Institute of Science and Technology (NAIST), where he published his first *PCP* paper reporting root cell-type specific localization of the enzymes (Nakajima and Hashimoto 1999). This work redirected his interest toward root anatomy, and led him to join the laboratory of Philip Benfey at the New York University, as a postdoc. While there, Keiji worked on a project investigating cell–cell movement of the SHR transcription factor in root patterning, while also appreciating the diverse ethnic cultures he was fortunate to experience. Since returning to NAIST, Keiji has been studying microtubule-oriented cell morphogenesis, miRNA-mediated tissue patterning in roots, embryos, and ovules, as well as the evolution of sexual reproduction using *Arabidopsis* and the liverwort *Marchantia polymorpha*. In 2020, Keiji joined the editorial team of *Plant and Cell Physiology*.

What inspired you to pursue a career in science?

Looking back on my early research career, I feel as though I was continuously pulled forwards by invisible threads tied to extremely interesting projects, respectable supervisors, and amiable colleagues. The first turning point was during my graduate study, while investigating the ability of some medicinal plants to produce opposite stereoisomers from a common substrate. I dedicated much of my time to enzyme purification, gene cloning, and X-ray crystallography, and finally discovered that evolutionary substitution of five amino acid residues switched the reaction stereo-specificity of conserved enzymes (Nakajima et al. 1993, 1998). During this study, my supervisor, Yasuyuki Yamada, continuously encouraged me to stay in science. Later as a postdoc, my then boss Phil Benfey offered me the opportunity to work on the big mystery of that time: how stele-expressed *SHR* is able to regulate endodermis differentiation in the surrounding layer (Nakajima et al. 2001). While this work is often cited showing a confocal image of GFP-*SHR* proteins, the hardest part was preparing the specific antibodies used to reveal *SHR* protein localization in nontransgenic backgrounds; GFP-fusion alone was not considered



Photo: Keiji Nakajima, Nara Institute of Science and Technology, Japan. Keiji joined the *Plant & Cell Physiology* editorial team in 2020, handling papers related to plant development.

reliable at the time. In both these projects, I worked really hard before finally making these great discoveries. These experiences cemented my career and enthusiasm for basic biology research.

How does your research impact society?

I have never intentionally tried to impact society through my work, but I am glad to see that some of our studies, which we initiated simply out of curiosity, have brought new concepts to plant developmental biology. Examples are studies demonstrating the role of non-cell-autonomous transcription factors and microRNAs in transmitting positional information in tissue patterning, and the evolutionary conservation of key transcription factors controlling highly diverse sexual morphologies of land plants (Nakajima et al. 2001, Miyashima et al. 2011, 2013, Waki et al. 2011, 2013, Koi et al. 2016, Hashimoto et al. 2018, Hisanaga et al. 2019). These studies were made possible by our own techniques and ideas, such as root-specific activation tagging, transgenic plants visualizing miRNA action and its phenotypic outcome, and comparative genetic studies of *Arabidopsis* and liverwort. From these studies, I learned that not only big technical innovations, but also individual ideas and inspiration born from biologists, are powerful driving forces that move science forward.

What is your favorite paper(s) in PCP and what papers would you like to see more of?

I like papers that bring conceptual advances in our understanding of biological systems and would like to see more of these papers in *PCP*. I think that *PCP* should stand as a journal publishing papers proposing new mechanisms and concepts, and answering central questions, for a broad readership. Among recent papers in my fields of expertise, I particularly enjoyed those reporting on the paternal control of zygote development by an AP2 transcription factor (Rahman et al. 2019), revision of the ABC model for rice flower development (Sugiyama et al. 2019), and the discovery of 'nutritropism' of lateral roots using a simple assay system (Yamazaki et al. 2020). Coincidentally, they all happen to be rice studies, pointing to the indispensability of this crop species as a model to understand principles in plant development, and the effective coverage of such studies by *PCP*.

Which exciting development(s) in your field has recently attracted your attention, and how do you see plant sciences progressing in the future?

Over the past decades, plant developmental biologists have put their efforts into elucidating key regulatory players, such as transcription factors and signal transduction components, and how they direct the growth of plants. Certainly, recent trends are geared at understanding how plant growth and development are dynamically altered in response to biotic and abiotic cues, and how organ morphologies and behaviors are regulated at the cellular and subcellular levels. Such studies have only been made become possible by advances in live-imaging, computer vision and theoretical modeling and their uses in multidisciplinary studies. I believe that this trend will further continue in the next few years. Accordingly, I recently launched an interdisciplinary research consortium in Japan, where plant biologists, theoretical biologists and computer scientists are working together to solve key questions in plant development (<https://plant-periodicity.org/en/>).

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