Reconstructing plant functions by regulating plant hormone actions

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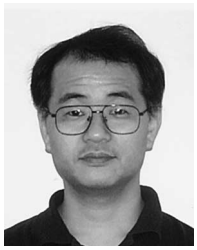

T. Asami

Brassinosteroids are essential for plant growth. Brassinazole, a brassinosteroid biosynthesis inhibitor developed in our laboratory, can be used to clarify the function of brassinosteroids in plants as a complement to brassinosteroid-deficient mutants. The use of this inhibitor enables the determination of mutants revealing novel brassinosteroid signal transduction pathways. Here we show p44, whose distinctive phenotype is exhibited only when it is treated with brassinazole.

Changing the degree of interaction between phytohormones in plants induces changes in their morphology and environmental adaptive capacity. This suggests that morphology and environmental adaptive capacity of plants can be controlled by artificially regulating their phytohormone system *in vivo*. Although the balance of the action of each phytohormone *in vivo* is adjusted to produce normal plants by controlling its transport, distribution in an organ or cell, and signal transduction systems, it is more directly regulated by controlling phytohormone biosynthesis and metabolism. This research focuses on morphological and biochemical changes in plants resulting from the imbalance in phytohormone levels caused by artificially regulating phytohormone biosynthesis. The results of this research will be of great help in elucidating phytohormone actions and producing plants with optional morphologies and functions. We have the following objectives:[1)] developing phytohormone biosynthesis inhibitors for regulating phytohormone biosynthesis;[2)] investigating the changes in morphology and function caused by inhibitor treatments; and[3)] screening mutant, whose phenotypes are exhibited only in the presence of a biosynthesis inhibitor, and identifying the gene(s) responsible for the mutaion.

As an example, a specific brassinosteroid biosynthesis inhibitor (brassinazole: Brz) developed in our laboratory[1–4)] induces dwarfism in *Arabidopsis*, as shown in Fig. 1, which indicates the importance of brassinosteroids in plant growth. This novel brassinosteroid biosynthesis inhibitor playing an important role in investigating the function of brassinosteroids, not only in plants, but also in tissues and organs, as well as in biochemical processes.[5, 6)] Moreover, the use of this inhibitor enables the determination of other mutants with novel brassinosteroid signal transduction pathways, as shown in Fig. 2. p44 was selected as a brassinazole-dependent mutant whose distinctive phenotype is exhibited only when it is grown on a medium containing brassinazole. Without brassinazole, this mutant exhibits the same phenotype as that of wild-type plants. This demonstrates the importance of phytohormone biosynthesis inhibitors in mutant determination.

We would like to contribute to the Bioarchitect Research Program by developing new phytohormone biosynthesis inhibitors and investigating inhibitor-dependent mutants.

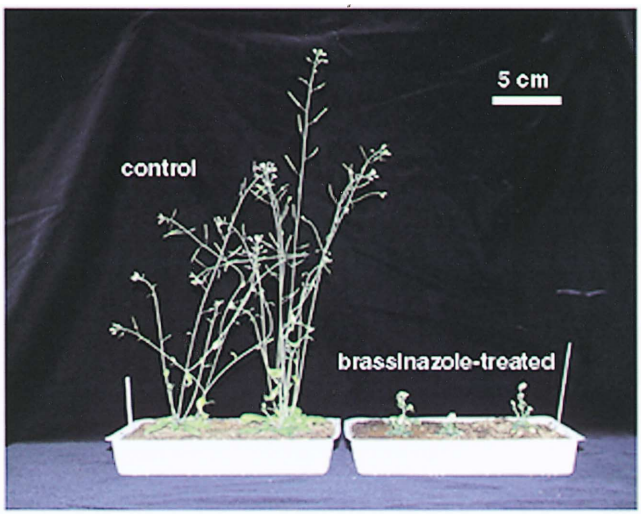

Fig. 1. 33-Day-old Arabidopsis grown in the light with or without Brz treatment.

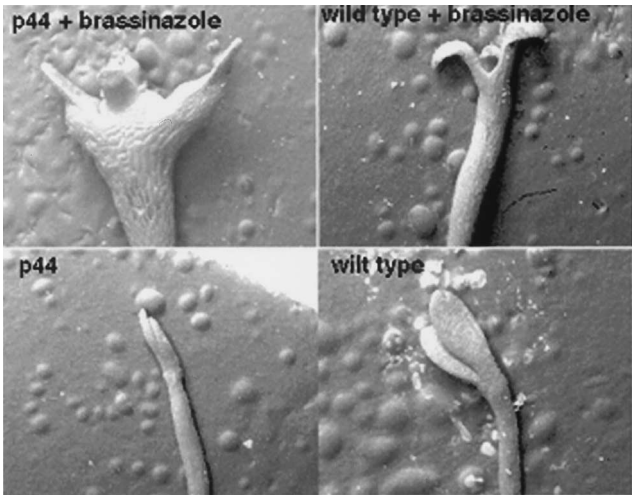

Fig. 2. Brz-dependent mutant P44, whose distinctive phenotype is exhibited only under Brz treatment.

References

1) T. Asami and S. Yoshida: Trends Plant Sci. **4**, 348 (1999).
2) T. Asami, Y. K. Min, S. Fujioka, S. Takatsuto, N. Nagata, K. Yamagishi, N. Murofushi, I. Yamaguchi, and S. Yoshida: Plant Physiol. **123**, 93 (2000).
3) T. Asami, M. Mizutani, S. Fujioka, H. Goda, Y. K. Min, Y. Shimada, T. Nakano, S. Takatsuto, T. Matsuyama, N. Nagata, K. Sakata, and S. Yoshida: J. Biol. Chem. **276**, 25687 (2001).
4) K. Sekimata, T. Kimura, T. Nakano, I. Kaneko, K. Yoneyama, M. Takeuchi, S. Yoshida, and T. Asami: Planta, in press.
5) N. Nagata, Y. K. Min, T. Nakano, T. Asami, and S. Yoshida: Planta **211**, 781 (2000).
6) N. Nagata, T. Asami, and S. Yoshida: Plant Cell Physiol., in press.