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*Plant genetics*

# Wood-forming genes active in mosses

*Key genes for wood development are expressed in mosses, hinting at an ancient evolutionary story*

Despite the distance between mosses carpeting a forest floor and the trees above, researchers have discovered that both groups express key wood-development genes. Although mosses lack wood, the genes originally played a central role in the migration of plants to the land.

When plants moved onto land, the absence of water presented them with the challenge of holding themselves upright and keeping aerial tissues hydrated. The evolution of special water-conducting cells, known as xylem, solved both problems, providing a continuous network of stiff tubes that support the body and deliver water. Vascular plants used this evolutionary innovation to carry themselves ever higher in the competition for light, from little flowers to towering trees in which xylem tissue forms the bulk of the biomass in the form of wood. Unlike vascular plants, mosses transport water through hydroids instead of xylem, and have remained small.

However, a group of key xylem development genes are active in the moss *Physcomitrella patens,* according to research carried out by a team at the Nara Institute of Science and Technology (NAIST) and other Japanese institutes[1]. The VND/NST/SMB (VNS) gene family regulates the differentiation of woody cells in vascular plants. While the *P. patens* genome is known to include several VNS-like genes, their function has remained unclear. The researchers studied the genes' expression patterns and used knock-out mutants to figure out their role in the development of *P. patens*.

Wild-type *P. patens* growing in soil.



"I didn't expect such clear results at first," says Misato Ohtani of NAIST's Graduate School of Biological Sciences. Several of the genes are expressed in tissues consisting of hydroids and other cells responsible for water transport and structural support. Mutant *P. patens,* with multiple VNS genes knocked out, have defective hydroids together with decreased water uptake.

The team is now looking downstream of the VNS genes to understand how different water-conducting tissues evolved in mosses and vascular plants. "I first guessed that *P. patens* would lack the second master regulators of woody cells, MYBs, and the biosynthetic genes for lignin," says Ohtani. To her surprise, homologs of both groups are expressed downstream of the VNS genes in *P. patens*, suggesting that a primitive form of the VNS-MYB pathway evolved before the divergence of mosses and vascular plants and became specialized in both lineages.

"Amazing!" says Ohtani. "We're starting to use several plant species, including a kind of algae, to explore this issue." Understanding how the VNS genes regulate the differentiation of water-conducting cells in different species could provide versatile tools for manipulating plant biomass.

## Reference

1. Xu, B., Ohtani, M., Yamaguchi, M., Toyooka, K., Wakazaki, M. *et al.* Contribution of NAC transcription factors to plant adaptation to land. *Science* **343,** 1505-1508 (2014).

More information about the group's research can be found at the Laboratory Of Metabolic Regulation webpage:
http://bsw3.naist.jp/demura/?cate=137