PLANT GENOMICS

Encoding beauty

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Credit: Image courtesy of Tianlong Zhu

Waterlily species are widely cultivated plants attractive for their beautiful flowers. Phylogenetically, they belong to the angiosperm order Nymphaeales, a lineage that diverged from the core angiosperms during the early evolution of flowering plants. Using up-to-date sequencing technology, Liangsheng Zhang from the Fujian Agriculture and Forestry University, China, and colleagues obtained a high-quality genome of the blue petal waterlily (*Nymphaea colorata*). Their analyses elucidate the evolution of waterlilies and the early flowering plants.

The researchers carried out phylogenomic analysis using orthologous low-copy nuclear genes, which supports that Amborellales and Nymphaeales are sister lineages that successively diverged from other extant angiosperms. A Nymphaeales-specific whole genome duplication was found by genomic collinearity and synonymous substitution analyses, possibly shared by the two families of Nymphaeales — Nymphaeaceae and Cabombaceae.

Whole genome duplication and tandem duplication generated about 70 MADS-box genes retained in the *N.colorata* genome, including the ABCE homeotic genes that determine floral organ identity. Most of the ABCE genes showed expression profiles consistent with their roles in floral organ patterning. However, overall, they exhibit a broader range of expression in floral organs than their homologues in eudicot systems, representing an ancient form of ABCE model for flower development. This expression model is consistent with the uniquely high similarities between sepals and petals in Nymphaeales species.

N. colorata flowers have floral scents attractive to insect pollinators. The researchers identified abundant terpene synthase genes and Nymphaeales-specific SABATH methyltransferases in the waterlily genome, which may catalyse the synthesis of these volatile compounds. Moreover, an anthocyanidin synthase and a delphinidin modification enzyme were found to catalyse the biosynthesis of anthocyanidin pigment that confers the attractive blue petal colour. Finally, genes related to biotic and abiotic stress responses expanded in water lilies, possibly leading to the wide adaptability of this lineage.

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