

# Why Flowers Look so Different: Understanding the Flexibility of Floral Structure and Its Underlying Mechanisms

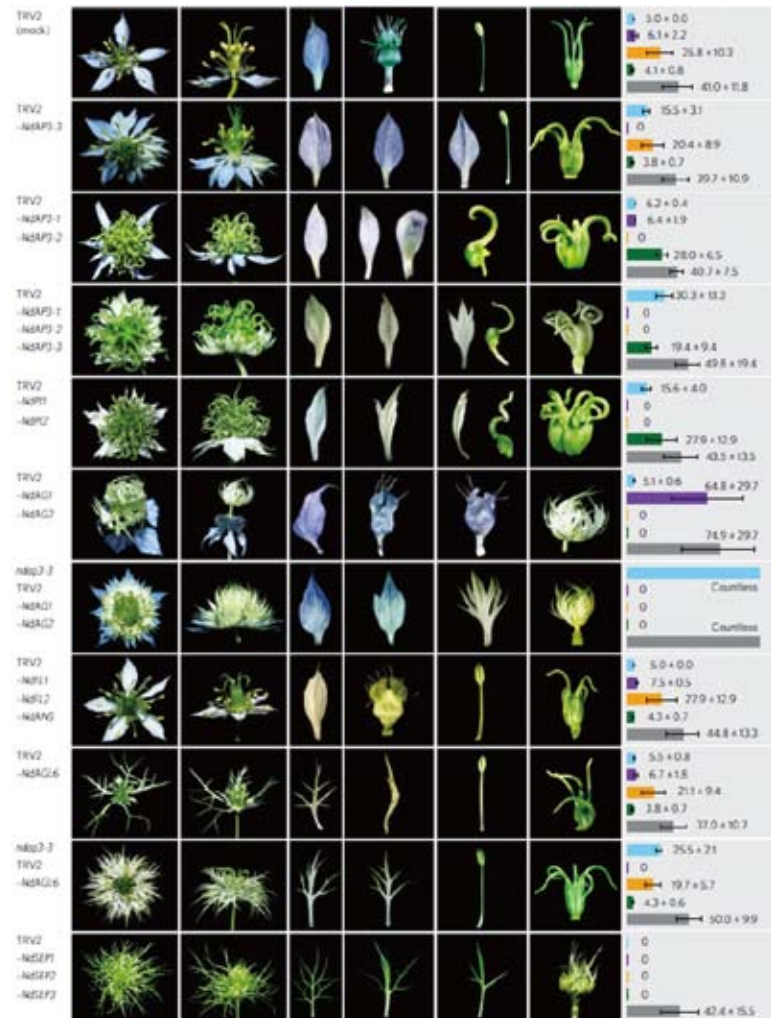
Flowers always show immense diversity in their phenotypes, including the arrangement of floral organs that can be whorled or spiral. In whorled flowers, the numbers of floral organs are usually fixed; in spiral flowers, in contrast, the numbers of floral organs usually show considerable variation, suggestive of the flexibility in the basic structure of the flower. The underlying mechanisms of the flexibility, however, remain unclear. Using *Nigella damascena* (Ranunculaceae) as a model, Prof. KONG Hongzhi's group at Institute of Botany, Chinese Academy of Sciences attempted to address this question.

They found that the total number of floral organs per flower varies considerably within and between individuals. Interestingly, although all four types (i.e., sepals, petals, stamens, and carpels) of floral organs vary in number, stamen shows the widest range of variation and is the determining factor of the basic structure of the flower. They also showed that the total number of floral organs per flower is largely determined by the initial size of the floral meristem whereas the respective numbers of different types of floral organs are determined by the functional domains of corresponding

genetic programs. By conducting extensive expression and functional studies, they further elucidated the genetic programs that specify the

identities of different types of floral organs and the molecular mechanisms underlying their variation. They found that: (1) the expression patterns

Phenotypes of VIGS-treated *Nigella damascena* flowers.



of most, if not all, floral organ identity genes are highly dynamic and show considerable variation between during flower development; (2) the dosage and duration of a gene required for the identity determination of one organ type may be different from that of another, so that a small change in the expression level of the gene may lead to alteration of the identity of the organ; (3) complex regulatory relationships exist among

different floral organ identity genes, so that a change in one gene may cause chain reactions in others; and (4) some floral organ identity genes also regulate the boundaries between different types of floral organs.

These findings suggest that the floral organ identity determination programs are highly dynamic and show considerable flexibility. Transitions from spiral to whorled flowers, therefore, may be explained

by evolution of the mechanisms that reduce the flexibility. These results provide new and important insights into the mechanisms underlying the flexibility and evolution of the flowers in structure.

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