

Genes responsible for difference in flower color of snapdragons identified

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Antirrhinum plants. Credit: David Field

Snapdragons are tall, charming plants, and flower in a range of bright colors. In Spain, where snapdragons grow wild, these flower colors show a remarkable pattern: When driving up a road from Barcelona to the Pyrenees, snapdragons of the species *Antirrhinum majus* bloom in magenta at the beginning of the road, before a population of yellow

flowering snapdragons takes over—separated by just a two-kilometer-long stretch in which flower colors mix. Such hybrid zones of snapdragons are quite infrequent; only a few others are known.

But why don't the snapdragons mix, with yellow and magenta [flowers](#) growing together over a wide area? Nick Barton at the Institute of Science and Technology Austria (IST Austria), together with David Field, previously postdoc in Barton's group and now Assistant Professor at the University of Vienna, collaborated with molecular geneticists at the John Innes Center in Norwich to investigate the causes of this pattern. Writing in today's edition of *PNAS*, the scientists report that they identified the genes responsible for [flower color](#) difference from DNA sequence data.

"DNA sequencing is becoming cheaper. But analyzing sequence data and interpreting the patterns is very hard," Nick Barton explains. "In this study, we used sequence data from *Antirrhinum* plants to locate the individual genes responsible for the difference in flower color across the hybrid zone." The researchers compared the genome sequences of 50 snapdragons of each color, and measured how much the sequences diverged between magenta and yellow snapdragon populations. By plotting a statistical measure of divergence between the two populations, they found "islands" in the genome which are more divergent between yellow and magenta snapdragons than the rest of the genome. In the snapdragons, these islands correspond to genes responsible for flower color. The recent paper focuses on two of those genes that determine the magenta pigment, and are located close together on the genome.

How the sharp difference between yellow and magenta populations is maintained was the subject of a Ph.D. thesis by Tom Ellis in Nick Barton's lab. Through observations both in the field and in experiments at IST Austria, he found that bees prefer to pollinate the most common color flowers in a [population](#): In magenta populations, bees mostly

pollinate magenta flowers; in yellow populations, bees mostly pollinate yellow flowers. This selection in favour of the commonest type keeps the hybrid zone sharp, and prevents exchange of genes that are linked to the flower color genes.

In the current study, the researchers wanted to know how the two snapdragon populations become different. They found two reasons that the snapdragon populations diverge at the flower color genes. First, selection has favoured new variants at the color genes that make the flowers more attractive to bees—causing these genes to sweep through the population, and leaving a sharp signal in the DNA sequences. Second, the flower genes become barriers to gene exchange. Any genes located close to or even between the flower genes cannot easily be swapped between the populations, and so the region of genome around the [genes](#) that determine flower color become divergent.

"Even with abundant DNA [sequence data](#), it is often difficult to find exactly why species are different. Our study is the culmination of years of work, combining fieldwork and population genetics with genetic crosses, and analysis of gene expression," explains Nick Barton.

More information: Hugo Tavares et al., "Selection and gene flow shape genomic islands that control floral guides," *PNAS* (2018).

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