

# Uncovering the genetic basis of hermaphroditism in grapes, the trait that allowed domestication

June 22 2020, by Andy Fell

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People have been harvesting grapes for at least 8,000 years. All wild grapes are dioecious, with male and female flowers on different plants. The introduction of hermaphroditism, so that plants have functional male and female flower parts, played a key role in domestication. Now UC Davis researchers have uncovered the genetics behind this process. Photo shows grapes in a vineyard at UC Davis. Credit: Gregory Urquiaga/UC Davis

Plant experts at UC Davis have defined the genetic basis of sex determination in grapevines, one of the oldest and most valuable crops worldwide.

In new research published in the journal *Nature Communications*, viticulture and enology professor Dario Cantu and Mélanie Massonnet, lead author and postdoctoral researcher in Cantu's lab, propose a novel model of sex evolution before and during grapevine domestication nearly 8,000 years ago. Their work could have broad application in breeding grapes and other [plant species](#).

All wild species of grapes (genus *Vitis*) are dioecious, which means that male and [female flowers](#) are located on separate [plants](#). Male individuals bear flowers with reduced pistils and female vines have flowers with reflexed anthers and stamens that produce sterile pollen grains.

Just one *Vitis* species, the cultivated grapevine *Vitis vinifera* ssp. *vinifera*, has reverted to hermaphroditism, leading to the advent of vines bearing perfect flowers with both functional pistils and stamens.

"It has always been a major challenge to identify the genes and mutations that lead to plant sexual differentiation," Cantu noted. "We show how the pivotal domestication trait of hermaphroditic flowers in [grapevine](#) is likely determined by the action of two separate genes contained within a sex-linked locus."

## Comparing sex determination genes in wild and domestic grapes

To unveil the [molecular mechanisms](#) associated with sex determination,

researchers constructed the genomes of two female and three male wild grapes, and five hermaphroditic domesticated accessions, including the chromosome-scale genome of Cabernet Sauvignon (the most widely planted wine grape cultivar in the world). They compared the structure of the sex determination locus, its sequence and [genes](#) between male, female and hermaphrodite individuals.

"The unprecedented amount of data generated here supports a model for sex determination in which recessive male- and dominant female-sterility mutations in ancestral hermaphrodite individuals gave rise to dioecious extant wild species, and a rare recombination event during domestication that led to hermaphroditism in cultivated grapevines," Cantu said. "From our findings, we propose that female individuals arise from a recessive deletion in a gene necessary for pollen germination, while male vines emerge from a dominant mutation in a second gene, resulting in female sterility."

The findings and the methods applied are particularly valuable for [grape](#) breeding efforts and to advance the understanding of sex determination in grapes and other plant species.

**More information:** Mélanie Massonnet et al, The genetic basis of sex determination in grapes, *Nature Communications* (2020). [DOI: 10.1038/s41467-020-16700-z](#)

Provided by UC Davis

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