

Good sports on the vine

A chance discovery in a vineyard has given CSIRO scientists an exceptional opportunity to find out more about how new grape varieties can come about.

In the 1970s at Langhorne Creek south east of Adelaide, viticulturalist Mac Cleggett noticed that one of his Cabernet Sauvignon vines had a single cane producing unusual bronze-coloured fruit.

Propagating buds from this cane resulted in a new cultivar he named Malian.

In a trial of the bronze-fruited Malian Mac also found a cane with only white fruit. This cane was also propagated to produce another new cultivar; Shalistin.

Mac's careful observation and record keeping of these varieties, known as bud sports, allowed the scientific study of a unique set of events.

The red or black colour in grapes is the result of the presence of anthocyanins in the skin of the berry.

Some grapes, such as Malian, have an intermediate colour, described as rose, grey or bronze. Pinot Gris is an example of a wine grape with grey berries.

Research at CSIRO Plant Industry in Adelaide found that red grape cultivars usually have two very similar genes (*VvMYBA1* and *VvMYBA2*) controlling anthocyanin synthesis.

These two genes are adjacent on the same chromosome and inherited together. When the scientists studied white grapes that had arisen as seedlings, such as Riesling and Chardonnay, they found that both genes had been mutated, but by different mechanisms.

All grapevines have two chromosome sets, one inherited from each parent. Some red grape cultivars have both a chromosome carrying the white genes and a chromosome with the red genes.



One example of this is Cabernet Sauvignon, which has a white chromosome contributed by its parent Sauvignon Blanc together with a red chromosome from Cabernet Franc.

Since the white cultivars studied previously were white because of two different mutations in the colour genes, the bud sports of Cabernet Sauvignon provided an opportunity to find out how a different type of mutation might result in white grapes.

The CSIRO scientists used microscopic examination of nearly ripe berries to determine that Cabernet Sauvignon had red cells in the several cell layers forming the skin while the bronze fruit of Malian had only one red cell layer (the epidermis) covering the berry. All the cells in the white Shalistin skin and flesh were uncoloured.

This indicated that the different cell layers in Malian might have altered colour genes.



Plants are quite unlike animals because the single cell layer covering the plant is specified early in the plant's life and continues to divide separately from the rest of the cells inside the plant.

When the *VvMYBA* colour controlling genes from Cabernet Sauvignon and the two bud sports were isolated and examined, it was found that the red version of the genes was missing in Shalistin. What's more, the red version and surrounding DNA had been deleted, rather than replaced by the white gene DNA. Malian, by contrast, still has the red genes but only in the very outer plant layer.

The researchers concluded that the deletion had occurred originally in the internal cell layers of the Malian plant.

This is known as a chimera, where the outer cell layer has a different genetic constitution from the rest of the plant. Chimeras have been reported in grapevine and are sometimes seen in garden plants, an example of which is variegated ivy leaves.

Shalistin was formed when a very rare event caused the outer cell layer to be invaded by internal cells in a bud.

This research showed that there was a second possible mechanism for the evolution of white grapes, particularly the bud sports. The Pinot group of vines has apparently gone through a similar evolution starting with Pinot Noir, Pinot Gris as an intermediate and Pinot Blanc as the white version. The provenance of the Pinot clones, however, is a mystery.

New wine varieties are being sought by an increasingly sophisticated market. This research highlights one of the ways in which new grape cultivars can become available for growers, winemakers and consumers that enjoy novel products.

References:

Walker, A.R., Lee, E. and Robinson, S.P. (2006) Two new grape cultivars, bud sports of Cabernet Sauvignon bearing pale-coloured berries, are the result of deletion of two regulatory genes of the berry colour locus. Plant Molecular Biology, 62, 623-635.

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