Grape genetics

Vine times

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The pinot noir genome is sequenced. GM wine, anyone?

In with the new...

THE battle between those who think character comes from nature and those who think nurture is the key is not confined to students of humanity. It lies at the heart of winemaking, too. For European growers, the variety of grape is important, of course. No one would mistake cabernet sauvignon for sangiovese or riesling for chardonnay. But grape varieties are normally propagated as cuttings; in other words, clones. What creates a wine's character, they argue, is the *terroir*—that mysterious combination of soil and microclimate that gives *appellations contrôlées* their cachet. In other words, the essence of a wine lies in its nurture.

Many New World winemakers would say phooey! to that. Where you grow your grapes matters—but no more than it does for any other crop. The true flavour is encoded in the genes and the consistency of a cloned crop is an asset. Environmental diversity is something to be resisted, not celebrated, since it masks the character of the grape and makes it difficult to produce a consistent product. It is not for nothing that the term “varietal wine” was invented in California.

As in the debate over human character, both sides have a point. But, again as in that debate, the naturist side of things is getting a boost thanks to the huge amounts of data on the role of genes that are flowing in. On December 18th that boost got bigger as the first full genetic sequence of a grape variety (pinot noir, as it happens) was published in the *Public Library of Science*. By unzipping pinot's genes, Riccardo Velasco of the Agricultural Institute of San Michele all'Adige, in Italy, and his team, have not only exposed many of the genetic secrets of this particular grape's flavours, they have also helped open the way for genetically modified wine.

In vino veritas

One surprising finding Dr Velasco made was the huge degree of difference, 11.2% in all, between pinot noir's two sets of chromosomes. Those sets of chromosomes come from the varieties originally crossbred to create the clone. These parental varieties must therefore have been very different from one another, for 11.2% is far more genetic variation than exists between, say, a chimpanzee and a human.

Dr Velasco's efforts have discovered a treasure trove of information for technologically oriented winemakers. His group has found hundreds of genes that encode enzymes which produce flavourings and aromatic compounds. That will help both those who want to make flavours more consistent and those who want to add novelty.

Knowing the pinot noir genome should also help people who would like to grow grapes in places now off-limits to them—either for climatic reasons or because local diseases would kill them. Florida is one example: it produces a few grapes for the table, but these are muscadines, a different species from those usually used for wine. Its wine production is a miserable one-tenth of one percent of the American market. The reason is that the state is home to diseases that clobber wine grapes. These include a bacterial infection called Pierce's disease, fungal infections such as mildews and rots, and viral diseases such as grape fanleaf virus and corky bark.

If Dennis Gray, a developmental biologist at the University of Florida, has his way, that will change. Dr Gray has been working for years on making vines resistant to these diseases by modifying their genes. This year he began field trials of grapes engineered to resist Pierce's disease and fungal infection.

Many people, though, hope that the problems of disease in grapevines may be solved without the sort of genetic modification that risks provoking consumer boycotts. Genetics may help here, too. An alternative to moving genes from one strain to another—the usual definition of genetic modification—is to create new varieties the traditional way by cross pollination, and then employ genetic-sequencing techniques to find out which progeny of such crosses have desirable combinations of genes in them.

Dr Gray is sceptical about this approach. When wild species of grape that have good disease resistance are bred with cultivated varieties possessing great qualities of flavour, he says, the result is almost always a wine of

lesser quality that has only some of the desired disease resistance. Better, he thinks, to pick your genes precisely and deliberately engineer them into the target. Moreover, since the gene-products in question rarely turn up in the flesh of the grape (they are actually produced in the stems, root, leaves and seeds), the wine from a genetically modified vine should not contain them.

Whether that will be enough to persuade European consumers, raised on the mystery of *terroir*, remains to be seen—particularly as the benefits of disease resistance are reaped largely by producers. But a bottle of Californian pinot noir with genetically enhanced flavours might be attractive to those with jaded palettes. As a result, research into genetically modified wine is going on in the Old World, too—even in such stick-in-the-mud places as France and Italy. After all, as one of the characters in Giuseppe di Lampedusa's novel “The Leopard” observes, “if we want things to stay as they are, things will have to change.”