OPPORTUNITIES FOR GRAPEVINE BIOTECHNOLOGY
Carole Meredith, UC Davis

American Institute of Wine and Food
21 July 1993

I. GENETIC ENGINEERING

The permanent and specific modification of an existing characteristic (enhancement or elimination) or the addition of a new characteristic.

Examples:

1. **Fanleaf-resistant rootstock**, by introducing a resistance gene into an otherwise good rootstock. Has now been accomplished by Moet researchers.
2. **Eutypa-resistant wine varieties**, by introducing fungus-resistance genes already proven in other crop plants.
3. **Pierce's disease resistance**, by introducing general antibacterial gene or resistance gene from PD-resistant wild grape species.
4. **Better color** in low color varieties or in low color regions, by enhancing anthocyanin production.
5. **Better acid** in warm regions, by enhancing tartaric acid synthesis.
6. **Stronger varietal character** by enhancing the synthesis (or reducing the loss) of specific flavor components (e.g., linalool).
7. **Reduction of browning**, by reducing polyphenol oxidase concentration.
8. **Enhancement of potential health benefits**, by increasing the concentration of specific compounds (e.g., resveratrol).
9. **Improved fermentation efficiency**, by enhancing limiting yeast nutrients (e.g., amino acids) in varieties prone to sticking.

Benefits:

1. Resistant vines are an alternative to pesticide use. In some cases, they will provide much more effective control than pesticides.
2. An engineered rootstock will leave the fruiting variety genetically unaltered. (But an engineered rootstock will not address pests and diseases that affect the top of the vine.)
3. The fundamental varietal character of an engineered wine grape will remain unaltered. Only the targeted characteristic is expected to be altered.

Costs:

1. Regulatory approval will probably be required initially for the production of transgenic grapes and wine. (But experience with more advanced crops like tomatoes is resulting in reduced regulatory barriers.)
2. Considerable research is necessary in order to bring this technology to fruition in grapes. Genetic engineering is well on its way to application in crops like tomato and cotton but grapevine research lags far behind.

II. GENETIC MAPPING

Identifying and analyzing the genes and regulatory factors that control important fruit and vine characteristics.

Examples:

1. Finding the genetic factors that control specific **flavor components**. Locating and studying such factors can lead to the identification of key flavor chemicals. The intensity of flavors for which a specific chemical has already been identified may be governed by other factors.
2. Finding the genetic factors in wild grapes that control **resistance to diseases** like Pierce's disease. Identification and analysis of resistance factors could lead to the enhancement of similar factors in wine grapes or the isolation and transfer of resistance genes from wild species to wine grapes.

Benefits:
1. Mapping the location of important genes (e.g., resistance genes) is a means by which such genes can be physically isolated and then introduced into varieties in which a new characteristic is sought.
2. Understanding the genetic basis of a characteristic leads to understanding the physiological and biochemical processes that shape it. This, in turn, provides opportunities for manipulating these processes by vine management practices. Thus, a flavor characteristic, for example, might be modified without altering the vine genetically.

Costs:
1. A research investment is necessary to first build a genetic map for grape, consisting of many "markers", before important features like disease resistance or flavor components can be located on the map. (Mapping technology developed for other crop plants is readily applicable to grapevines.)

III. DNA PROFILING

Using DNA analysis methods to produce objective and characteristic profiles ("DNA fingerprints") of important wine varieties and clones for the purposes of identification and comparison.

Examples:
1. Establishing the true identity of **Petite Sirah, Zinfandel, Valdepenas** and other California wine grapes whose European origins are unclear.
2. Determining whether some of our wine grape varieties whose authenticity has been questioned (**Chenin blanc, Merlot**) are correctly identified.
3. For important wine grape varieties, determining **which clones we already have** in California before trying to import more from Europe.
4. Determining whether, at the DNA level, **our Zinfandel can be distinguished from European clones of Primitivo.**
5. Instituting a standard procedure by which to **certify the identity of UC Foundation plantings.**
6. Providing a means for **nurseries to verify the identity of material** they sell.

Benefits:
1. Rectify identification errors.
2. Avoid international legal action.
3. Facilitate international exchange of information on clones and varieties.
4. Protect the market for California Zinfandel.
5. Protect nurseries, growers, vintners and consumers from misrepresented grape varieties and clones.

Costs:
1. New identity information might result in mandatory label changes for established products.
2. Elucidation of the true European identity of "California" varieties could increase foreign competition for some California wines.
3. Particularly in the case of clone identification, a research investment is required before an identification method can be developed.