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Recent Advances in Viticulture Practices to Improve Winegrape Quality In Napa Valley, California, USA

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ABSTRACT

Napa Valley wine grapes command the highest value for any grapes grown in the United States. In order to maintain and improve the wine quality from these grapes, growers and wineries are looking at methods to optimize the viticulture practices in the field. The use of technological advances such as normalized differential vegetation index (NDVI) photographs, and irrigation scheduling based on leaf water potential readings, and evapotranspiration rates have helped to improve quality and uniformity. Advances in cultural practices such as: shoot thinning, shoot positioning, fruit thinning, and leaf and lateral removal have also contributed to the improvement in quality. Finally, the use of computer technology in the form of weather data, and interactive databases has assisted winemakers and viticulturists in determining what factors are affecting the development of wine quality.

INTRODUCTION

Napa Valley has close to 20,000 hectares of vineyards planted, similar to the amount in all of Japan, and produces over 150,000 tons of grapes. The average grape price for the county is $3000/ton, which is by far the highest average price for any county in California. Some varieties like cabernet sauvignon, and petite verdot can command prices up to $8000/ton, which make them the highest valued grapes in the United States. Growers and wineries are looking for methods to optimize viticulture practices in order to maintain and improve grape quality.

Winegrape improvement program- these are ongoing programs that depend on three important factors:

1. Industry funded University research- these scientifically valid studies are critical to the basic processes for winegrape production and for problem solving demonstrations.
2. Winery cooperation- wineries must be willing to devote time and labor for experimental lots of wine.
3. Vineyard implementation- growers must be willing to donate time, labor, land, and grapes to these experiments.

Cultural practices-these practices are critical for the improvement of quality in winegrapes

1. **Pruning**- pruning weights are taken during the fall to help determine the levels of pruning that are needed in the winter. Dr. Smart used a scale of 5-10 as optimum for a fruit to pruning weight ratio. Dr. Kliewer used more moderate numbers

of 4-6 as optimum. In Napa Valley most growers use a lower fruit to pruning weight ratio, usually in the 3-5 range. This helps to create the optimum balance in the vine for producing premium quality wine.

2. **Shoot thinning**- early season shoot thinning is essential for controlling shoot growth and spreading out the fruit. In general, shoots are thinned to the number of original count buds that are left at pruning.

3. **Leaf and lateral shoot removal**- this is very critical in high rainfall areas that do not dry out readily, but only a minimal amount of leaf removal is needed in most warm areas. Dr. Dokoozlian has done extensive work on the effects of row orientation and direct sun exposure. We have seen severe sunburn and berries shriveling on overexposed clusters. The current practices for leaf removal is to remove the bottom two leaves and laterals in cooler areas, and only lateral shoots in the hotter areas.

4. **Early cluster thinning**- this is done shortly after fruit set and is used to help regulate crop levels. All fruit on shoots less than 30 cm should be thinned off, shoots between 30-60 cm should have only one cluster, and shoots 60 cm or longer should have two clusters. Clusters that are touching should be thinned to evenly distribute fruit.

5. **Late cluster thinning**-In red grapes, as clusters begin to approach full color, clusters that are still mostly green should be thinned off.

6. **Shoot positioning and tipping**- Shoots should be placed between the catch wires so that the shoot is straight up and spaced evenly in relation to neighboring shoots. The tip of the shoot should be removed as the shoot grows past the top wire.

Irrigation scheduling- in areas with low summer rainfall, this can be the practice that has the most profound effects on wine quality.

Dr. Wample and others showed that early season water deficits had the most positive effect on wine quality.
Dr. Pritchard did work on quantifying this early season vine stress through the use of pressure chamber readings
Dr. Williams developed irrigation strategies based on using only a percentage of the actual vine use.

Regulated deficit irrigation strategies are based on the above research and uses an integrated approach:

1. **neutron probes**- records the actual soil moisture and is very useful early in the season if it is used to compare to previous season's starting dates.
2. **pressure chamber**- this measures leaf water potential or the amount of stress that the vine is under. Normally for white grapes we will use –10 bars as the starting point, and –12 bars for red grapes.
3. **shoot tip readings**- these are visual observations of the shoot tip and tendril to check stress levels of the vines. Optimum vine growth is evident from the tendril growing actively past the growing tip. Vines showing early stages of stress will have the tendril shorter than the growing tip. Moderate stress is shown by the tendril being absent but the tip still intact. Higher stages of stress are evident from the shoot tip stunting and eventually drying up.
4. **calculating irrigation amounts**- the actual irrigation amount is calculated from evapotranspiration data (ET), crop coefficients (canopy shading), and the desired % deficit. Normally, we will compute this amount on a weekly basis and use 40% of ET for white grapes. Red grapes will be irrigated at 40%ET prior to veraison and 30% after

veraison.

Technological advances-

1. **weather stations-** We are using a network of stations that record and transmit data every 15 min. by radio telemetry. This is collected from a base station by phone modem and summarized on a website that can be accessed from any computer. This has been used effectively in disease management decisions and in computing ripening curves. Irrigation scheduling and heating and cooling control measures are also monitored with these weather stations.
2. **Normalized differential vegetation index (NDVI)-** these multicolored photos are used to determine where there are non-uniform areas that need extra water or fertilizer. These can also be used to delineate areas for differential harvesting.
3. **Database and neural networks-** growers have kept extensive databases recording data at the block level such as: yields, pruning weights, phonological dates, irrigation amounts, nutritional data, fertilizer and fungicide use. Wineries also have extensive data such as: wine quality, laboratory data, fermentation rates, and barrel use. Dr. Block is working on a project to merge this data from several producers and wineries to determine what viticulture practices have the most effect on wine quality.

Winery inputs- there are many things that wineries have done over the years to improve wine quality. A few that have a direct effect on vineyard operations are:

1. smaller harvest bin size- A two ton bin used to be standard for most wineries, but over the last 10 years the ½ ton macrobins have become commonplace.
2. cluster and berry sorting- culling out clusters in the vineyard at harvest is fairly common, but some wineries now use sorting belts before crushing the grapes to cull out unwanted grapes and stems.
3. separating blocks in the vineyard and at the winery- this is essential in the analysis of wine quality and in determining how to improve the wine in subsequent years.

In summary, it is essential that there is cooperation between University researchers, winery personnel, and vineyard workers in order to continue to improve the quality of winegrapes in Napa Valley.