Summer Viticulture Operations-VMT 229
Summer Session 2014

Take-Home, Open Book Final Examination

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1. Describe the set of operations that are referred to as canopy management. Make sure to discuss shoot positioning and leaf removal. List the goals of these operations.

Canopy management starts with trellis selection and row orientation, where consideration is given to those selections best suited to utilize available sunlight. Anticipated vine vigor impacts on vine spacing, and soil characteristic and soil moisture will influence vigor. The style of pruning selected, be it cane or cordon, will define the ideal grapevine from which canopy management operates.

The follow relate to canopy management in a more modern trellis system that supports vertical shoot growth:

A. Dormant season pruning attempts to keep the grapevine close to the ideal, where crop size is balanced against vine vigor. Shoots that were able to grow five feet long in a season, reflect a vine near good balance; longer is too much vigor, shorter is not enough. If pruning cuts (for cane or cordon) cannot follow the text-book selections, then new wood is selected to serve as spur or cane and selection is driven by position and wood health. Suckers are not used as new wood.

B. Vines have the suckers removed in April. Suckers are shoots that grow off the trunk, or off the cordon, and are not the shoots that normally grow from the pruning cuts.

C. Shoots are tucked between support wires when they have grown long enough, in June. Lateral shoots that point out into the vineyard can be cut off. Laterals come off the mains shoots that emerged from the buds left by pruning, and are not part of the ideal. Growing vines in vertical position improves the affectivness of foliar applications, and generally facilitates vineyard management.

D. Leaf removal is done usually on the morning side of the vine, leaving leaves on the afternoon side. By removing leaves in the fruit zone, this opens the fruit to sunlight and air circulation which will protect against powdery mildew and Botrytis bunch rot, respectively. Leaf removal also improves fruit quality, by improving color and reducing pyrazines and pH. Unfortunately, removing too many leaves runs the risk of sunburning the fruit.

E. Hedging by machine (or tractor) is done to manage growth on vines that are showing too much vigor. Hedging may cut laterals (or other growth) that stick out into the row, and also the growing tips on shoots tucked through the support vine. Unfortunately, cutting the growth tips (apical meristem) off may stimulate the growth of laterals. Because leaves will live only 150 days, young leaves are needed on the growing tips to provide needed photo synthesis through the harvest.

2. For the diagnostic method known as tissue analysis, briefly explains how the samples are collected and how laboratory results are interpreted. Discuss how errors might occur.

Petioles (or leaf stems) and blades (or leaves) are collected at bloom, by taking the leaf opposite the flower. If more information is needed, a second sample can be collected at the same location at veraison.

A good sampling is about 100 leaves (petioles and blades) collected throughout the vineyard block to achieve a representative sample for that block. The petioles and blades are separated, placed in paper bags, then boxed and shipped by overnight delivery to the laboratory. Separate samples and laboratory tests are needed for each block under management.

The laboratory results report the concentration of nutrients found in the plant tissue, for nitrogen, phosphorous, potassium, zinc, boron, and several others. These are compared to standards that are also returned in the same report, informing vineyard management if concentrations are low, high, or in a normal range. For example, if a deficiency is discovered, the selection of fertilizer and the time and method of application is a separate vineyard management decision that should be initiated.

Errors can come from several places. Leaves can be selected poorly, generating a non-representative sample. Samples can be contaminated. They should be collected in a clean plastic bucket prior to packaging. If for example, leaves are then placed in a plastic bag (rather than a paper bag) then mold might grow on the sample, and this can through off the results. The time of day samples are collected and field conditions may also have an impact on laboratory results.

Blade samples provide a more accurate test for nitrogen than do petiole samples. Rainy or chilly days can shut down the movement of nitrate through the petiole to the leaf, creating misleading fluctuations in the laboratory results.

3. Describe how a grower can estimate the water needs of the vine. Explain how the estimates can be done both before and after veraison. Make sure to mention the use of the pressure chamber readings and explain the basis principle involved with this device.

Visual inspection may reveal vines growing fast with the leading tendrils growing past the leading leaves on the apical meristem, with pale or yellow-green and succulent leaves in apical meristem. This conditions indicates that the grape vine has found adequate soil moisture. Short internode length indicates slow vine growth, and a vine that did not find adequate soil moisture. Depending on soil depth, and if spring rain brought the soil to field capacity, at some point in the summer the water needs of the vine will need to be supplied by drip irrigation. If one waits to see the first signs of wilting, the farmer has waited too long. Alternatively, drip irrigation can be started early, to reserve the soil moisture deeper in the soil, so it is available later in the summer.

It is better to measure soil moisture (tensiometer, gypsum block, or neutron probe), or vine water stress (pressure bomb), to better anticipate the water needs. Regardless of how soil moisture (or water need) is measured, readings should be calibrated with what was found in past years, adjusting for winter and spring rainfall, so as to better anticipate the real-time condition.

The pressure bomb measures the sucking pressure found in a selected leaf, found at a representative location in the vineyard. Leaves that acquire high sucking pressure show water stress because they need that pressure to draw water up through the roots. Leaves should be selected from different locations. The selected leaf is placed in a pressure chamber within 10 seconds of clipping, rapped in a plastic bag. The sucking pressure is measured in the reverse, as the amount of pressure needed to compress the leaf and push water out of the stem where it was cut.

Plants require water for cell division and photo synthesis. Before veraison, vines need water for both of these functions, and so they need more water; e.g., a water stress of -12 bars (or lower) indicates inadequate soil moisture to support cell division. After veraison, vines require water only for photo synthesis, and soil moisture should be managed at a "sweet spot" between about -12 and -15 bars showing in the pressure bomb (not enough for cell division but below the permanent wilting point).

4. List several insects and diseases that may do damage to the vine during the summer season. For one of either an insect or disease, describe the biology, life cycle and control practices in more detail.

Typical diseases of the summer are powdery mildew (from bud break to versison) and Botrytis bunch rot (near harvest). There are some lethal, or potentially lethal, diseases of the grapevine that will impact on vine health throughout the year, namely Pierce's disease and Eutypa Dieback. There are a number of virus that will impact of vigor, and fruit quality and quantity, including Grape Leafroll Virus and Grape Fanleaf Virus.

The Grape leafhopper will feed on leaves, doing damage. Pacific mite and Willamette mite will also do damage to leaves. Vine Mealy Bug and Grape Mealy Bug can infest grapevines, feeding of plant tissue, damaging the plant and fruit. Mealy bugs can spread leafroll virus. The Blue-green Sharpshooter and the Glasswing Sharpshooter spread Pierce's disease. Nematodes (unsegmented worms) will damage the root system in some rootstock, and the Dagger Nematode can spread fanleaf virus. Phylloxera (aphid family) can damage the root system of non-resistant rootstock.

Powdery Mildew is a significant challenge. It is caused by Uncinula necator, a fungus that can overwinter on bud scales as mycelium, or as sexually produced ascospores contained in cleistothecium that are produced in late summer. Ascospores are released by spring rain, and can start fresh infections. Infections already on the bud scales grow with the plant, and the mycelium grow conidia spores asexually and create new infections. Temperature is the most important environmental factor influencing the development of powdery mildew, and the cool springs that are typical of the North Coast are problematic. It is best to manage powdery mildew by anticipating it, and hitting it early by spraying a wetting agent, with wet sulfur, when the shoots are about 2 inches; as done in the vineyard at Napa Valley College. Repeat two more times at 6 to 8 inches, and at 12 to 15 inches. The wetting agent will kill the mycelium, and the sulfur will kill the spores. Later, sulfur dust can be applied in 7 to 10 day intervals to kill off any spores, thereby preventing new infections. Wetting agent, or a fungicide, may be applied again if field inspection reveals an infection that had not been controlled by early management. Nevertheless, by the time of veraison the grape berries are immune to new infections of Powdery Mildew, and control methods may be dropped. However, it may be necessary to drop already damaged fruit.

5. Explain the process of crop estimation. List the data required to make an estimate. Make sure to mention the underlying mathematical formula used to make the estimate.

Crop estimation is done to estimate the size (or the number of tons) of the grape harvest in a block. Samples are collected after the berries are set, well before harvest, to estimate the average number of berries per cluster, and the average number of clusters per vine. Collecting 25 randomly selected clusters is sufficient to estimate the average number of berries per cluster. The clusters are brought to a comfortable work environment where the number of berries on each cluster are counted, then averaged. Counting the number of clusters on each of 10 vines is sufficient to estimate the average number of clusters per vine. The10 vines may be selected randomly, or the same vines may be selected each year to control for some of the variation. The number of tons estimated for the block is computed as:

(# berries per cluster) X (# clusters per vine) X (# vines per block) X (tons per berry).

Where,
berries per cluster is the estimate of average value already described,
clusters per vine is the estimate of average value already described,
vines per block is a known quantity,
tons per berry is a very small number (or the inverse of a large number) and is estimated by the linear regression of tons on number of berries coming from prior harvests. [side note: class notes refer to crop wight per cluster, but this is just an equivalent alternative coming from the linear regression, where tons per berry is the crop wight per cluster divided by # berries per cluster and with appropriate adjustments for the units of weight used.]

Some estimation methods don’t involve counting berries on clusters, rather what is done is that the clusters are weighed to find an average weight per cluster. This avoids counting berries, and the implied regression analysis, but it introduces errors because cluster weight will vary as harvest approaches and then it becomes necessary to introduce a correction that will account for how the cluster weight will change.