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Calculating pruning weights & factors to consider when monitoring vigor in Western Oregon using balance pruning

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Every January Oregon wine grape growers begin the task of pruning their vineyards. Generally, 'rough pruning' begins by making large cuts and leaving canes long to be 'finished pruned' later when the threat of freeze injury has largely passed. During finish pruning, canes are tipped and tied on the fruiting wire. When making selections of the larger cuts during cane pruning, the head of the vine should remain below the fruiting wire so canes are easily bent and tied to the fruiting wire during finish pruning. The number of canes left to tie down later will depend on the size of the vine and training system. The predominant trellis/ training method for cane pruning Pinot noir in the Willamette Valley is the Double Guyot (two canes), Vertical Shoot Position. Vineyards grown on hillside soils with limited depth using devigorating rootstocks such as 101-14 with a Double Guyot training system are used with the intent to produce smaller vines with lower yields. Growers may also use Single Guyot (one cane) and one spur and train the one cane to the next vine. On sites with deeper soils and vigorous rootstocks such as 5C, growers will often use the Scott Henry training system, a laterally divided training system, to increase the number of buds to balance the vines growth. Balancing vine growth during pruning will aid the grower later in the growing season when performing canopy management.

One way to balance vine growth or vigor is through balance pruning. Carmo Vasconcelos of the OSU Department of Horticulture has encouraged growers to adopt balance pruning as part of their pruning program. A common method used among growers and researchers is to choose five vine reps throughout the block to be evaluated. Vines are 'rough pruned' where all wood is removed except for the renewal spurs and the selection of canes to be tip and tied to fruiting wire. Next the one-year-old prunings (wood that is smooth) are weighed. A standard fish scale can be used and purchased at most sporting good stores. The number of five vine reps depends on the size and uniformity of your block. Make the calculation to determine the weight of one-year-old wood per vine. Generally, great variation exists, and the crew must adjust for vines that are significantly larger or smaller than calculated average. The total number of buds to leave on the vine during finish pruning is dependent on the weight of the one-year-old-wood. Growers who practice this method on Pinot noir in the Willamette Valley use 27 to 33 buds per kilogram of one-year-old wood. If the calculations indicate 18 buds per vine are necessary, then the grower can instruct the crew to leave two canes with 8 buds each and one two-bud spur. Choosing the number of buds per kilogram within this range will be necessary for each site, variety, rootstock, and plant age. Due to the many factors that influence pruning weights, the number of buds per kilogram is not static. Periodic

evaluation (e.g. every other year) of pruning weights is necessary to confirm pruning management.

Caution is advised when using this method in pruning! Practices through out the growing season such as vineyard floor management (cover crop) can affect vine vigor via competition. Cover crop competition, shoot thinning, canopy hedging, and fruit load will all influence canopy growth and consequently the amount of one-year-old wood. Balance pruning can be used as a tool to measure vigor. Cycles of high and low vigor can occur, and methods to control cycles will be discussed.

Cycles of high and low vigor occur when the vine's vigor is not fully evaluated for its potential. The vine's potential to produce fruit, one-year-old wood, and carbohydrate-reserves interact with the 'vineyard management practices'. Management practices include cover cropping, irrigation, and fruit load (e.g. thinning). Vineyard management practices and plant age will influence the differences in pruning weights between vintages, making balance pruning a dynamic process. Seasoned cane pruners learn what the vines are capable of by monitoring the amount of one-year-old wood the vine is producing. Visual evaluation of the previous year's cane length and diameter during dormant pruning season is often the method used to determine how much wood to leave behind. However, if a particular vineyard block's performance continues to produce low tonnages with challenging wine chemistry, balance pruning can help the grower readjust the pruning regimen. Balance pruning can demonstrate the need to leave lower number of buds when pruning. The method of adjusting the cane length to be wrapped on the fruit wire during pruning is often changed year to year. Besides pruning to a lower bud number, the grower may decide to alter cover crop, irrigation or fruit load. If more than one adjustment is made within one year, then the amount of one-year-old wood will change to a greater degree. The number of buds per kilogram of pruning weights of 27 to 33, is adjusted to the block's change of management.

The complexity of the interaction between management practices such as plant materials selected, vine age, and soil type will influence the number of buds per kilogram of one-year-old wood. In general, deeper soils require lighter pruning so that early shoot growth is obtained. Over zealous pruning on deep soils can lead to late shoot growth during fruit ripening. Late shoot growth can compete with fruit for carbohydrates. Lighter soils require heavier pruning, which helps channel the limited nutrients taken up by the roots to fewer buds. When pruning for soil type, one must consider the performance of the plant material used on the site. Varieties and rootstocks vary considerably with respect to vigor. Oregon growers who have chosen the rootstock, 101-14 on a site with limited water and shallow soils, are experiencing some challenges during dry summers. Growers can educate themselves to the potential long-term outcome of choosing a variety and rootstock for the site in mind.

Vine spacing becomes an important part of the equation. The rootstock 101-14 on shallow soils will have to be planted at a closer spacing, if it is to fill the fruiting wire. If planted too far apart, balance pruning will often demonstrate that vines should be pruned heavily. The fruiting wire may have gaps and fruit development will vary with the varied light exposure.

Interest in 'within-block variability' has increased for wine makers producing reserve wines. Research is underway at OSU by Jessica Cortell and Jim Kennedy in Food Science and Tim Righetti in Horticulture. They are looking at how precision agricultural

techniques can be used to identify zones of management within a vineyard block. Variations in vine vigor between zones within one vineyard block are largely due to soil depth and water holding capacity. If growers can identify zones of variation of vine vigor within a vineyard block, then they can adjust vineyard management practices to facilitate uniformity. Uniform fruit maturity within a vineyard block is first adjusted during pruning. Balance pruning, bud number per kilogram of one-year-old wood can be adjusted between zones of management within a given vineyard block. Zones or areas within the vineyard block that are similar in vigor can be pruned similarly. Vines with similar vigor can have the same bud number. Adjusting bud number will balance the vine's leaf-to-fruit ratio, allowing the vine to ripen fruit more uniformly. Ultimately, a uniform block will lead to uniform fruit maturity. Uniform fruit leads to better wines because the wine maker will be fully aware of the fruit that is arriving from a particular block with few surprises. A smoother vinification results from consistent values of Brix, TA, and pH received during fruit sampling just prior to harvest.

The calculation of leaf area per fruit ratio during the growing season has been used to measure a vine's optimum capacity. The estimate of $10cm^2$ leaf area per gram of fruit was once proposed as an optimum leaf area to fruit ratio, but research has since shown that the optimum ratio is varietal and climate dependent. Pinot noir requires a greater leaf area in the maritime Northwestern United States than Shiraz in Eastern Australia. Trellis training system will also influence the efficiency of leaves by virtue of their location within the canopy with respect to sunlight. Vertical shoot positioned Pinot noir in Western Oregon has been adopted to maximize leaf capture of sunlight. Canopy management during the growing season becomes extremely important to maximize the leaves' photosynthetic capabilities. Positioning shoots vertically is carried out several times so that there is little leaf overlap, therefore maximizing the capture of sunlight. This in turn maximizes carbohydrates and sugar production.

Dormant pruning principles are important to understand when evaluating a vine's capacity to produce an optimum canopy size and crop load. It is also necessary to monitor vigor of the canopy throughout the growing season when evaluating the swings in high and low vigor. Vigor can be adjusted by canopy management techniques such as shoot and cluster thinning. Canopy management is a subject matter that many researchers have devoted much of their careers to. OSU Viticulture Extension is developing a training video on canopy management for vineyard personnel. The first video will be released in 2004.

It's also important to understand that fruit induction (formation of flowers) begins the previous year during a four-week period around the time of bloom. Microclimate conditions within the canopy and vine nutrition will influence fruit induction. Proper light penetration and nutrition levels at the buds during bloom are necessary for the following season's yield. Pruning will influence the canopy microclimate. For example, severe pruning of mature vines delays bud break, leads to excessive growth of the remaining buds, activates dormant buds (which cause shading), and increases the induction of second and third crops. A balanced vine does not carry the attributes, which causes excessive shading. Balancing the vine at pruning by adjusting bud numbers will lead to proper light exposure. The canopy is at the optimum size with maximum leaf exposure to ripen the fruit load targeted.

Colder regions or sites often require that growers leave more buds than are calculated through balance pruning procedures. Freeze injury during the winter may kill the viability of buds, and early frost in the spring can burn back shoots that have emerged. Growers in colder sites have to wait till the danger of frost has passed to adjust the final bud number. Leaving extra canes (whether spur or cane pruned), until freeze and frost injury has been fully evaluated, gives the grower more buds to choose from as an insurance in obtaining the necessary yield of the block. Extra canes can be loosely tucked in catch wires or allowed to hang down within the vine row. An extra labor step is necessary to cut and pull out a calculated number of shoots in the spring. The amount of shoots retained is dependent on bud survival rate. Some growers practice a method of direct observation of sectional buds with a razor blade. The compound bud, which houses the primary, secondary, and tertiary buds, is visible with a lens. Cut the buds longitudinally and look for necrotic regions within the bud. The primary shoot, which generally carries two clusters on Pinot noir, is the larger bud in the center. If primary bud is necrotic in multiple buds on the same sample vine, then leave extra canes and adjust shoot number later in the spring. During the 1989 and 1990 freezes, OSU Horticulture performed evaluation of bud mortality by varieties and an Extension publication was completed. Reporting on bud mortality and other winter related issues will be covered in a future paper.

Growers can use direct observation of buds and/or balance pruning to predict vine capacity for production. Historic values for every site can provide growers with further insight into the necessary pruning management to optimize the vineyard's potential. Tools like bud sectioning and balance pruning become necessary to provide the winery with the fruit tonnage and quality answers they need.

Apical dominance can be demonstrated on shoots growing from unpruned grape canes that are vertically shoot positioned. Upper buds will show the greatest fertility and shoot growth. The lower buds may not even break when left unpruned and are not laid horizontally on the fruit wire. Arching canes during pruning has been used to slightly alter apical dominance and provide an increase in even growth across the cane during the growing season. Training systems will be covered in a future publication.

Pruning severity using balance pruning has been studied for many years in New York State. Much of the research there has focused on *Vitis labrusca* and French-American varieties where 30 buds are retained for the first pound of one-year-old wood, and 10 buds are retained for each additional pound. Cordon pruning is popular in New York with the standard suckering of trunk, head, and cordon arms during the growing season. In examining the differences between New York and Oregon. Carbohydrate reserves are generally higher in cordon training, thereby reducing the swing in vigor between years. In Oregon, cane-pruned vines may have lower carbohydrate reserves, which may result in greater shifts in pruning weights if not managed properly. To the extent shifts occur in Oregon is not well understood. The roll of soil, cover crop, water, and fertilizers can have a tremendous effect on shifts in pruning weights in cane-pruned vines.

The complexity of the site, soil, plant material (rootstock and scion), plant age, cover crop, water availability, and vineyard inputs will all play a role in the level of pruning weights for your site. Developing historical values of pruning weights for two to three years can help you dial in your vineyard site for each block. Instruction to pruning

crews will become easier with predictable results. Wineries will support your efforts towards uniformity. Contracts are retained and fulfilled with fewer headaches. Labor savings is realized from fewer remedial actions during the growing season, when pruning is done in an effective manner. Pruning sets the stage for the growing season and balance pruning is a mathematical tool to help predict vine growth. Although your crews are ready to work, send two of your best ahead of the others to calculate pruning weights. Isolate average values for each block or zone of vigor and maintain the lowest error rate feasible. Your decision to adjust bud numbers is as good as your sampling.

If you are a new grower, instructional methods in the field will bring you closer to understanding viticulture. If you are a seasoned grower with a sixth sense for your site, do you see shifts in vigor or difference in zones that could be managed differently?

OSU Viticulture Extension would appreciate any feedback you may have. Please take the time to complete the following survey. Return to the author's mailing or email address listed above. Or follow this link to an online version of the form.

Thank you, Anne Connelly

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