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The Effect of Thinning Time, Thinning Level, and Vine Size on Concord Juice Quality

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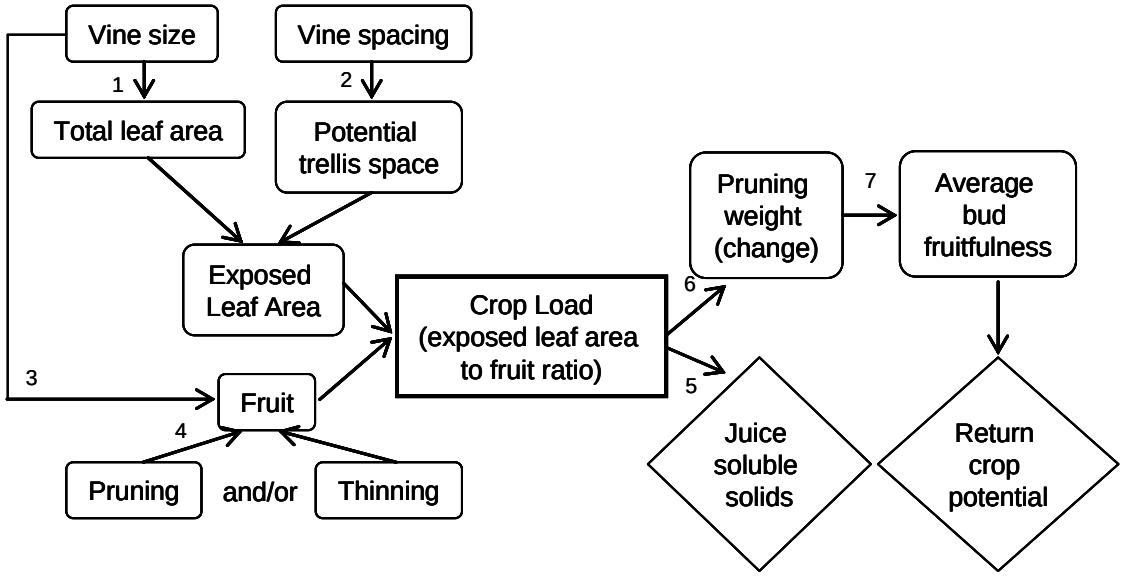
Introduction

From 1999 to 2003, the effect of mid-season crop adjustment on Concord growth, productivity, and fruit maturity was studied. Each year, Concord vines at the Fredonia Vineyard Laboratory were pruned to 120 nodes and subject to a variety of crop or leaf area adjustments. The impact of these treatments on fruit sugar accumulation, vegetative growth, and return productivity was measured. The following report pools and summarizes the data collected in the series of experiments. For additional information on this research project and mechanically thinning Concord, please refer to the 2003 progress report and the article, Concord Crop Adjustment: Theory, Research, and Practice. Both reports can be found on the web at http://lenewa.netsync.net/public/Bates/Home.htm.

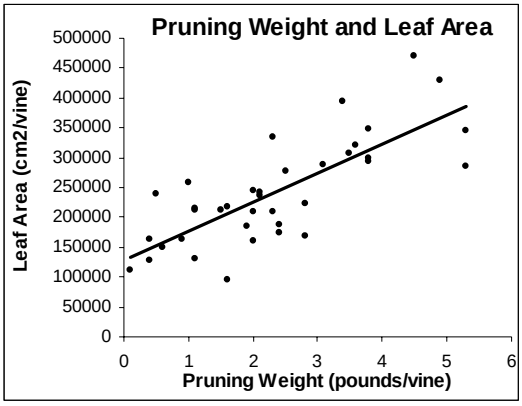


Mid-season crop adjustment or "thinning" is an additional tool in vineyard crop load management. Crop load can be defined as the ratio of exposed leaf area to fresh fruit weight on a vine. Therefore, to manipulate vine crop load, it is important to understand the factors that influence this ratio. This flow chart illustrates some of the major factors that influence either potential exposed leaf area or crop level. In addition, the flow chart shows how crop load

management influences fruit maturity and vegetative growth. Numbers 1-7 on the flow chart represent figure numbers in the report that more specifically illustrate the relationships in the flow chart.

Figure 1. Total vine leaf area increases with vine size

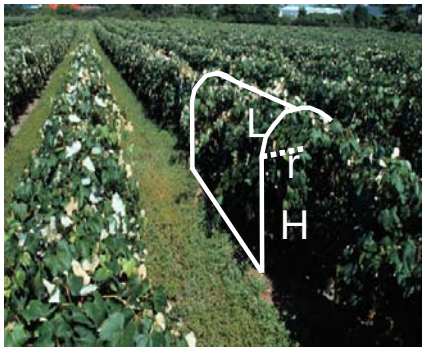
One of the reasons dormant cane pruning weight has been used to measure vine size and potential vine productivity is its relationship to potential vine leaf area. The assumption is: the healthier the vine, the greater the cane pruning weight, and the greater amount of potential leaf area depending on pruning severity. Although the relationship between pruning weight and leaf is intuitive to most producers, we measured vine leaf area on 120 node vines to quantify the relationship between vine pruning weight and leaf area (Figure 1).



As expected, there was a positive linear relationship between vine pruning weight and total vine leaf area. Balanced pruning research by Dr. Shaulis showed on Concord at 9 foot row and 8 foot vine spacing that maximum vine productivity was reached between 2.5 to 3.0 pounds of cane pruning weight. Canopy division on larger vines was needed to further increase vine productivity. Therefore, our first assumption in manipulating vine crop load is that optimum leaf area on standard (non-divided) trellis is approximately 22-25 square meters (2.5 pounds of prunings/vine).

Figure 2. Potential exposed leaf area is limited to the allotted trellis space

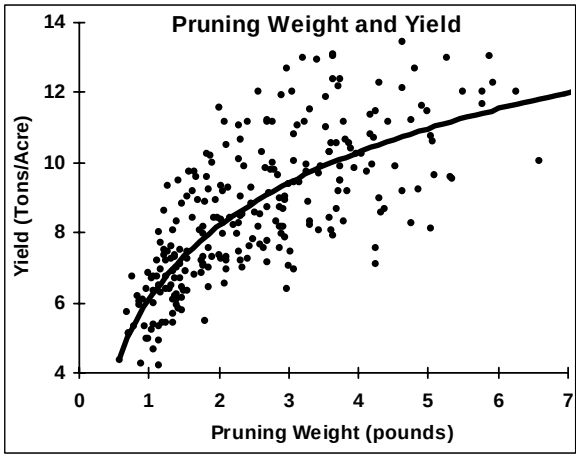
The relationship between pruning weight and leaf area indicates that a 5 pound vine (at 9 foot row and 8 foot vine spacing) can have almost 40 square meters of total leaf area. However, it is unlikely that all of that leaf area will be exposed and available for sunlight interception unless it has unlimited trellis space to spread over. Canopy dimensions on the 120 node experimental vines were measured to determine the maximum allotted trellis space for vine leaf area.



Canopy research by Richard Smart suggests that functional leaf area is limited to 1.5 leaf layers. Therefore, canopy surface area was multiplied by 1.5 to calculate maximum functional trellis space. Pruning weight, total leaf area, and allotted trellis space together suggest that maximum functional leaf area is approximately 22 square meters. Therefore 22 square meters was used as the upper limit in the following crop load calculations.

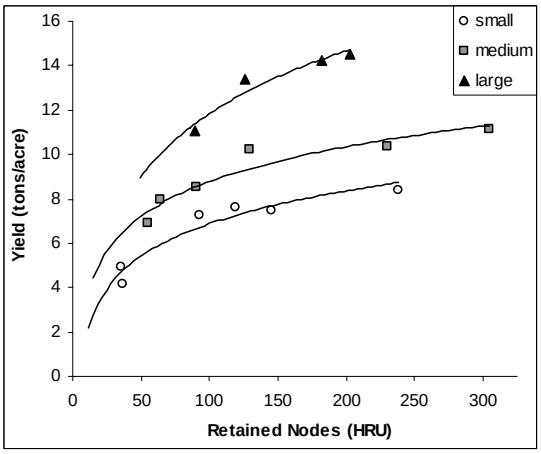
3. Yield potential increases with vine size

Pruning research by Dr. Shaulis clearly showed the relationship between vine size and yield potential. Therefore, vine size influences crop load by influencing both the leaf area and the crop size. If thinning is going to be used as a tool to maximize crop potential in any given growing season, the vines or vineyard should start with a crop level greater than an average season can ripen and then reduced to match the current season growing conditions. Maximum yield potential increases with vine size. Therefore, large vine size should be a pre-requisite for maximum vineyard yield potential and effective crop load management.



4. Yield potential increases with increasing bud number (within limits)

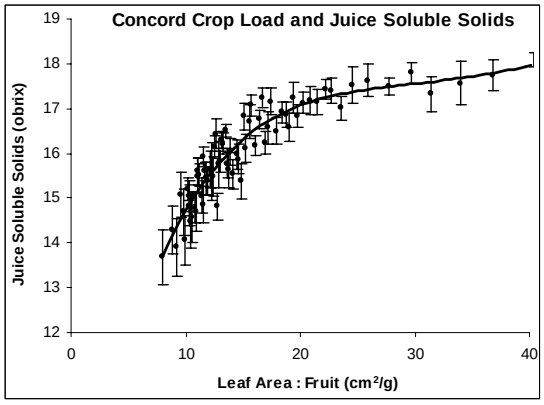
From the three-state juice quality project, it has been shown that maximum potential yield can be achieved in NY at 120-130 node pruning and that the delay in fruit ripening at this bud number when compared to lower bud number pruning is primarily a yield effect. Leaving more than 130 buds with hedge pruning or minimal pruning does not increase yield but does continue to delay fruit maturity because of canopy inefficiency. Therefore, 120 node pruning was used in our experiments because it gives maximum crop potential while maintaining the structure of a hand pruned canopy, eliminating potential canopy inefficiencies. In addition, since the rate of fruit maturity is primarily a yield effect in 120 node pruning, the vines should respond strongly to crop adjustment. This figure also shows again the effect of vine size on maximum yield potential. Small vines cannot reach the yield potential of larger vines no matter how light the pruning severity.



5. Crop load management influences juice quality

Using the data from figures 1-4, our experimental crop load manipulation was as follows: A relatively uniform block of Concord grapevines on standard trellis at 9 foot row and 8 foot vine spacing, pruned to 120 nodes for maximum crop potential, and measured for vine size, total leaf area, and allotted trellis space. Exposed leaf area was calculated from these measurements and crop weight was measured on thinned and unthinned vines at harvest. The exposed leaf area and crop weight data were used to calculate crop load.

The following figure shows the relationship between crop load and juice soluble solids in Concord over a five year period. Maximum fruit maturity was achieved when there was between 15 and 20 square centimeters of exposed leaf area per gram of fruit. Above a crop load of 20, there was no further increase in juice soluble solids and below 15, there was a sharp decrease in fruit maturity.



6. Crop load management maintains vine balance

One of the goals in crop load management is to maintain vine balance – i.e. ripen the largest possible crop in any given year while maintaining vine size. In our experiments, we measured the initial and final pruning weights of crop adjusted vines. The following figure shows the positive relationship between calculated crop load and pruning weight change. Similar to the juice soluble solids information, a zero change in pruning weight occurred when there was a leaf area to fruit ratio of 15. Therefore the vines were "balanced" (maximum fruit maturity with no change in vine size) at this crop load. If a grower is trying to improve average vine size in a vineyard, a crop load value greater than 15 would be desired.

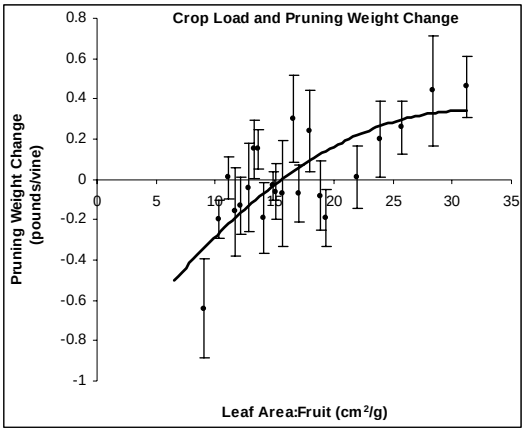
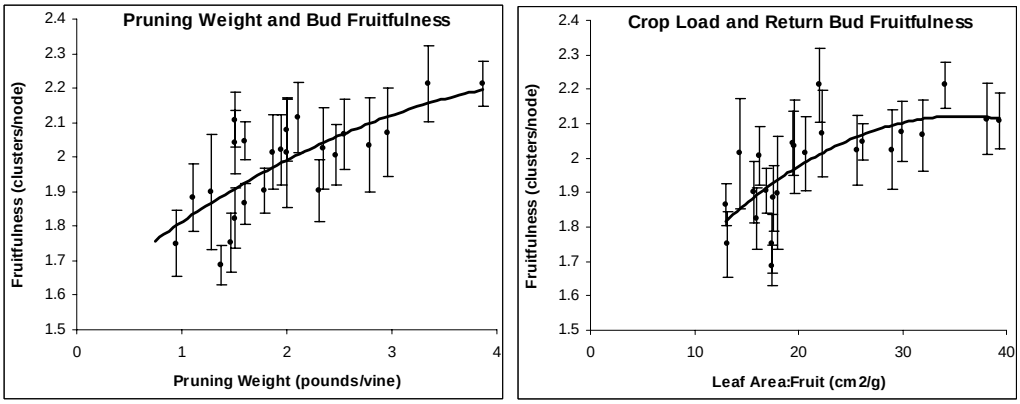


Figure 7. Crop load in year one can impact yield potential in year two.

There was a positive relationship between vine pruning weight and average bud fruitfulness (average clusters/node). This supports Dr. Shaulis' pruning weight and yield relationship in figure 3. Therefore, crop load management in year one affects both fruit maturity and vegetative growth. Vegetative growth (wood maturity) affects return bud fruitfulness and return crop potential in year 2.



Conclusion

Traditional crop load management in the vineyard used vine size and balanced pruning to maintain vineyard productivity. The research on mid-season crop adjustment shows that it is possible to prune for maximum crop, whether that be 90 node pruning on small vines, 120 node pruning on medium size vines, or 150 node pruning on excessively large vines and then crop adjust for the current growing season conditions. The data supports the successful use of thinning as a tool to manipulate vine crop load and that crop load can impact current season fruit maturity, current season vegetative growth, and average return bud fruitfulness.