Sampling and estimating average pruning weights in Concord grapes

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Background. Vine size is an important component of vine balance and cropping potential. In cold climates, measuring the weight of pruned wood from a vine, or a section of the cordon, is the preferred approach for quantifying vine size. However, it is not widely used in commercial vineyards because of the time required for taking the measurements, which is affected by the difficulty of separating intertwined canes and the overall interruption to pruning to accumulate and weigh the prunings. Our goal was to use the data from an intensive survey of pruning weights to determine the optimal sample size and sampling method to estimate the mean vine size in vineyard blocks.

Experimental design. At the end of the 2009, 2010, and 2011 growing seasons, the weight of pruned wood was measured for each individual vine within a 0.93 ha, mature Concord juice grape block at the Cornell Lake Erie Research and Extension Laboratory in Portland, N.Y. In total, 1192 vines were measured each year. Four sampling approaches were used to analyze the data. A consecutive sampling scheme method pooled data from adjacent individual vines into groupings of 2, 3, 4, and 5 consecutive vines along the rows. This gave a total of 549, 353, 254, and 193 data points in the vineyard, respectively. For each approach, the pruning weight variance and mean were calculated, and a mean variance over the three years was calculated. The sample size needed to reach a 90% confidence level for mean pruning weight was calculated. In addition, a geo-statistical analysis was used to determine if the variance increased with the distance between sampling points.

Results. The average pruning weights and their variance are shown in Table 1. The variance for a given strategy was similar across all three years, and the variance decreased with increasing

numbers of vines sampled. Averaging over two or more vines halved the variance, indicating a high vine-to-vine variance.

Table 1. The yearly mean and variance of pruning weights using five different sampling strategies across three years.

Sampling strategy	Mean pruning weight			Variance			Mean variance	Sample size for a 90% Confidence Interval
	2009	2010	2011	2009	2010	2011		
1-vine	0.483	0.379	0.471	0.052	0.047	0.051	0.05	64
2-vines	0.487	0.386	0.478	0.025	0.025	0.027	0.026	32
3-vines	0.486	0.384	0.477	0.02	0.02	0.015	0.018	23
4-vines	0.488	0.386	0.475	0.015	0.016	0.015	0.015	19
5-vines	0.49	0.385	0.474	0.014	0.013	0.014	0.013	17

A grouping of three vines, which in typical Concord juice grape production would equal the area between two posts, would require 23 samples to estimate the mean pruning weight in a field. The geo-statistical analysis showed that only data within a 0.17 ha area were auto-correlated, which is smaller than the study area. This suggests that, as long and management and environmental conditions are consistent, the proposed sampling schemes could be employed over a larger area than was used in this study. Grouping to a post length gives a fix frame within which to sample and avoids having to disentangle vines, reducing the effort of sampling.

Conclusions

- Vine-to-vine variation in pruning weight measurements are high.
- Aggregating the data from neighboring vines decreases the variance in measurements.
- Aggregating the three vines between posts would require 23 samples to estimate the mean pruning weights of a block with 90% confidence.
- If management and environmental conditions are uniform across a block or across multiple blocks, this approach can be used without additional sampling points.

The bottom line: Sampling methods that aggregate the pruning weights of consecutive vines between fixed post lengths increases the feasibility, maintains the accuracy and decreases the cost of collecting vine size data.

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