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Shoot-based sampling of *Vitis vinifera* clusters

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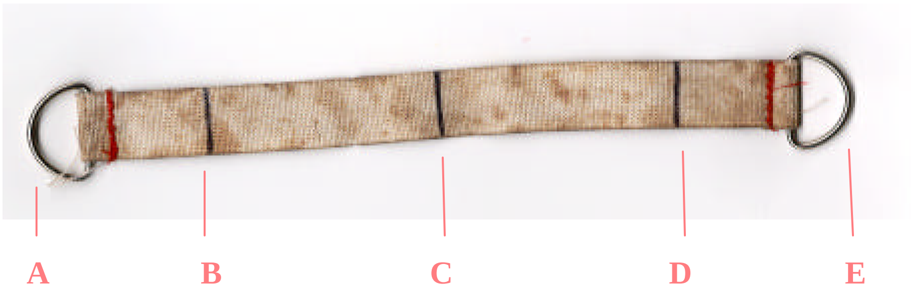
- In cluster sampling, a small number of sampled clusters (typically, 30 to 100, depending on block size) are assumed to be representative of an entire block. This means it is crucial that the sampling methodology avoids statistical bias. There are generally 2 basic sampling procedures: *random* and *systematic* (non-random, regular pattern). Whatever the procedure, a good sampling method should ensure that the samples contain a proportionate number of *basal clusters* and *apical (second) clusters*. The goal of this study was to test a sampling technique consisting of a mixture of both random and systematic approaches, as well as to get a good understanding of how clusters are affected by their position on the vine.

- The sampling technique the authors tested is called “random-systematic-random”. That is, the vines are sampled at random; then the shoots are sampled systematically; and, finally, the clusters along a shoot are sampled randomly again. Here is in a bit more detail how the authors conducted the sampling.

- To avoid an overrepresentation of short rows, rather than selecting row numbers at random, the authors selected *pairs of numbers* at random. The first and the second number in the pair represented the row and the vine, respectively. Then, if a given row number did not contain the corresponding vine number – because the row was too short-, the pair was discarded. This way, the authors selected 12 rows and 48 vines within those rows. Cordons –right or left- were alternated among the vines selected. Shoots on a cordon were selected using five pre-selected positions marked on an elastic band (A, B, C, D, E, with A being the shoot closest to the trunk, and E the most distal) that they stretched to fit the length of each cordon. Finally, one cluster was selected randomly from each shoot.



- The experiment took place in Napa, California, first as a pilot sampling in 2003, then as a full-scale sampling in 2004. This latter sampling included 5 blocks: 2 of Cabernet Sauvignon, 2 of Merlot, and 1 of Chardonnay. Using the technique above, the authors sampled a total of 192 clusters from each block.

- **Results**.

1) **Cluster weights tend to be larger if the shoot has two clusters than if it has only one.** [*This is a remarkable finding with very important sampling consequences*].
2) Yields tend to increase as the average number of clusters per shoot increases.
3) Basal clusters tend to be slightly larger than second –apical- clusters. The size fluctuation among basal clusters (the standard deviation) is also much larger than among second clusters, which tend to be more homogeneous in weight.
4) Longer cordon lengths were correlated with higher yields.
5) Clusters tend to have the same weight regardless of the position of their shoot along the cordon. That is, clusters on shoots closer to the trunk (position A) are similar in size to clusters on shoots at the end of the trunk (position D).

The implication of this work is that, because shoots with 2 clusters tended to bear larger clusters than shoots with 1 cluster, if you are sampling only from "normal looking", two-clustered shoots –and avoiding single-clustered shoots- you are going to overestimate yield. Similarly, if you take both clusters from a single shoot, you are going to increase the probability of those clusters being larger than if you randomly took them from the whole "cluster population" – again, because shoots with 2 clusters tend to carry heavier clusters. This latter finding is extremely subtle, and it takes statisticians such as Tarter and Keuter to point it out to us. This is the main contribution of this study. As the first author kindly explained over the phone, the only way –or most practical way- to avoid this bias would be to do "a random sampling of a single cluster from each pre-selected shoot".

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