Spatial distribution of berry fresh mass, seed number and sugar concentration on grapevine clusters of Shiraz

Discussion of potential consequences for sampling to monitor vineyard ripening

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Research has examined the spatial and temporal evolution of single berry fresh mass and sugar concentration between Shiraz grapevine clusters. The results can be used to improve vineyard berry sampling for assessing ripening or the need for berry sorting in wineries.

Berry asynchronous development and heterogeneity within single clusters remains an important research question that is linked to berry volume (skin-to-pulp ratio) and composition (i.e. quality) and has practical implications for:

- sampling for research and/or practical aims, such as assessing vineyard ripening
- vineyard management (i.e. the effect of cultural practices such as irrigation)
- wine styles and quality (i.e. is berry sorting needed in the winery?).

The asynchrony of berry development within clusters originates from flowering and flower fecundation. Grapevine berry growth occurs across three main stages: green growing stage, véraison following the lag phase and ripening. One to four ovules per ovary could be fertilised by pollen during flowering leading to one to four seeds per berry, but only one normal seed per berry is enough to ensure normal berry growth. However, climate and micro-climate within the fruit zone (light, temperature, water), nitrogen supply and vine physiology will dictate individual berry development and composition.

Shiraz clusters grown in the experimental vineyard of SupAgro in Montpellier, France, were harvested and analysed on a per branches/ramifications basis from top (R1) to bottom (R14) (Figure 1). The analyses within clusters included the spatial distribution of single berry fresh mass,

Figure 1. Measuring berry fresh mass and seed number per berry distribution within a cluster (Shiraz) on a per branches/ramifications basis from top (R1) to bottom (R14). The number of berries per branches depends on their position on the cluster: the top branches always have more berries than the bottom one.

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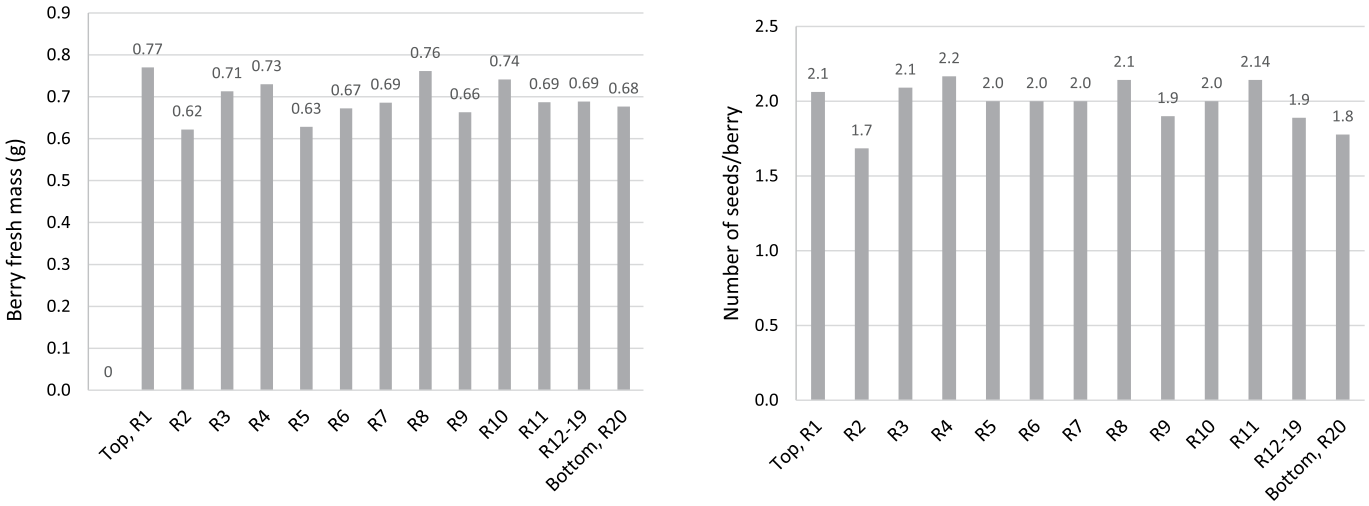

Figure 2. Spatial distribution of average berry fresh mass (g) and seed number distrubution on a Shiraz cluster from top to bottom ramifications/branches. Each value is the average of five to 15 berries depending on the berry number per branches or group of branches.

seed number per berry and, from early véraison onwards, berry sugar concentration (°Brix). From these analyses, the following observations have been made:

- there is no gradient or logical spatial distribution within clusters in berry development/berry fresh mass and sugar content (Figure 2)
- there is no clear relationship between berry seed number and fresh mass (Figure 2)
- the heterogeneity of berry development increases from green growth stage to ripening (Figure 3)
- berry fresh mass is poorly linked to sugar concentration (°Brix) (Figure 4)
- in comparing three sampling methods (single berries, cluster branches and whole clusters), no significant differences were observed for Brix° and pH values (Figure 5, page 45)
- therefore, recommendations for grapevine berry sampling are proposed in Figure 6 (page 46).

PERSPECTIVES

These results provide new information about the asynchrony and heterogeneity of berry development within and between clusters that originates, at least partly, from the timing of flowering and flower fertilisation. Cluster and berry heterogeneity can be observed across all cultivars. Heterogeneity during berry development is likely to be enhanced by the spatial variation of abiotic and biotic factors and crop management within vineyards including topology, microclimate, soil structure and depth, diseases, pruning and so on.

Measuring berry heterogeneity in vineyards is an essential method to assess potential issues and for comparisons of genotypes, environment and/or cultural practices. However, this study showed that the heterogeneity in berry composition resulting from sugar accumulation or seed number cannot be

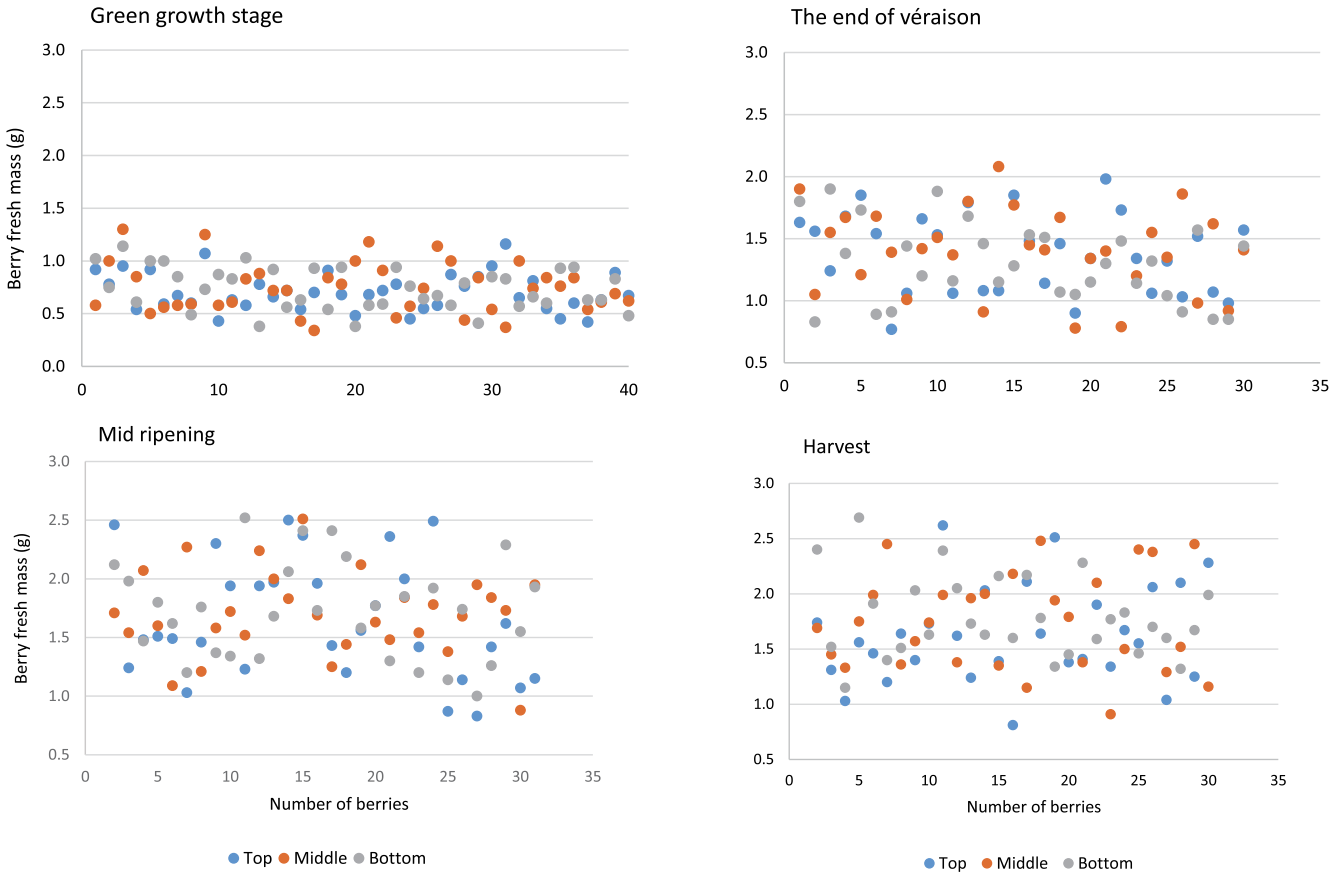

Figure 3. Berry fresh mass distribution across a cluster of Shiraz at the green growth stage, the end of veraison (15.2°Brix), mid-ripening (21-23°Brix) and the end of ripening period (26.2°Brix). The measures have been done on a per berry basis sampled at top, middle and bottom of 30 clusters.

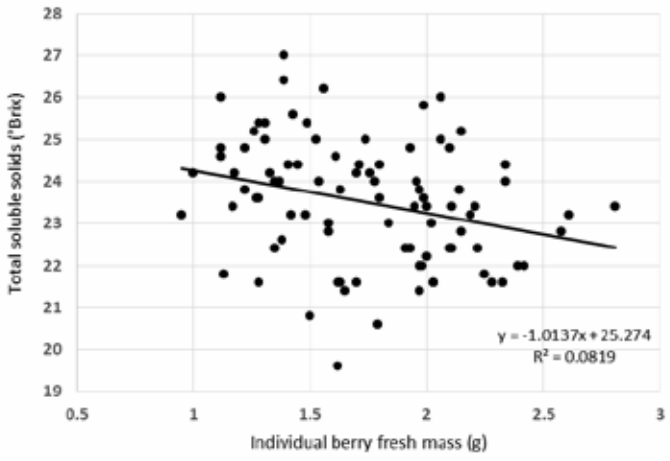

Figure 4. Relationship between individual berry fresh mass and total soluble solids (°*Brix*). It is interesting to notice the poor relationship between individual berry fresh mass and its sugar concentration. This means that berries of the same volume have different sugar content (mg/berry).

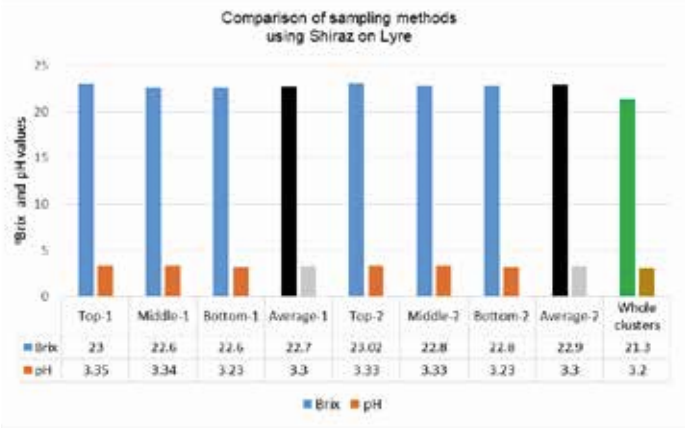

Figure 5. Analytical results for Brix and pH for different sampling methods and the associated berry numbers (Shiraz, Lyre, Montpellier SupAgro experimental vineyard, 21/08/18). Sampling method 1: 30 berries at, respectively, top, middle and bottom positions of 30 bunches; Sampling method 2: five to eight berries at, respectively, top, middle and bottom positions of 30 bunches; Sampling method 3: 10 clusters from the same rows and vines.

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Figure 6. Recommendations for sampling either for research or to follow ripening. It is even possible to do some analyses on a per berry basis depending on the research questions.

Individual berries sampling
For research trials
The best method when the amount of fruit is limited
To follow ripening
Drawbacks: time consuming, cluster compactness

Cluster branch sampling
For research trials
Not recommended if limited number of vines and clusters
To follow ripening
Drawbacks: time consuming, cluster compactness

Clusters sampling
For research trials
Not recommended (removing more than 10% of clusters from a vine could affect the whole ripening process)
To follow ripening
Most recommended

simply inferred from berry size.

Is it possible to reduce berry heterogeneity? Certainly, yes, but it is impossible to avoid it. Even homogeneous vineyards will have vines with heterogeneous clusters and berries. Whether reducing abiotic constraints such as water limitations at specific berry developmental stages may reduce berry heterogeneity is a question that deserves attention.

Ultimately, these results can be used to better address questions of berry sampling and sorting depending on the objective (Figure 5):

- sampling for research to test a specific scientific hypothesis
- sampling for wineries to assess ripening and the associated cost and working load
- berry sorting in the winery per size or sugar concentration.

If a method is working for you, continue with it and always do the same!

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