HARMONISING GRAPEVINE PHENOLOGY RECORDING FOR BUDBURST AND FLOWERING AS RECOMMENDED BY THE PERPHECLIM PROJECT

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Introduction

Using common languages and methods in the grapevine community for assessing developmental stages is a key issue to facilitate the comparison of data between vineyards and experiments. This allows building long homogenous and reliable datasets that can be used to follow the impacts of climatic changes, to build models for predicting phenological stages in the future or to help growers in their timing to implement management practices. Methods are proposed for assessing budburst and flowering validated in a network of researchers working on grapevine in France in the framework of the PERPHECLIM ACCAF project.

Material and methods

The BBCH scale (Biologische Bundesanstalt, Bundessortenambt und CHemische Industrie) is widely used to describe phenology, both for monocotyledons and dicotyledons, in annual and perennial crops (Meier, 2001). We recommend to use the descriptions of grapevine developmental stages proposed by Lorenz *et al.* (1995) on the basis of this BBCH scale. Correspondences between the main stages of the BBCH scale, the widely used "Baggiolini" scale (Baggiolini, 1952) and the "Modified Eichhorn-Lorenz" ("Modified E-L") scale as proposed by Coombe (1995) are provided in the next sections.

Budburst is considered when a given bud reaches stage BBCH 07 (Figure 1). This corresponds to Baggiolini stage C and modified E-L stage 4.

- Only adult and productive plants with their final architecture are observed.
- A bud is counted as burst when a green or red tip is visible.
- Only primary buds are observed.
- The BBCH07 stage corresponds to the date when 50% of buds are burst when compared to the total number of buds left after pruning.
- Counts on at least five plants are required.
- Observation frequency: first observation when a minimum 5% and a maximum of 49% of the buds are burst. At least one more recording is necessary in order to have a value between 51 and 99% of buds burst. The delay between two recordings should not exceed one week.
- The date when 50% of the buds were burst is calculated by interpolation between the recorded values (at least two).

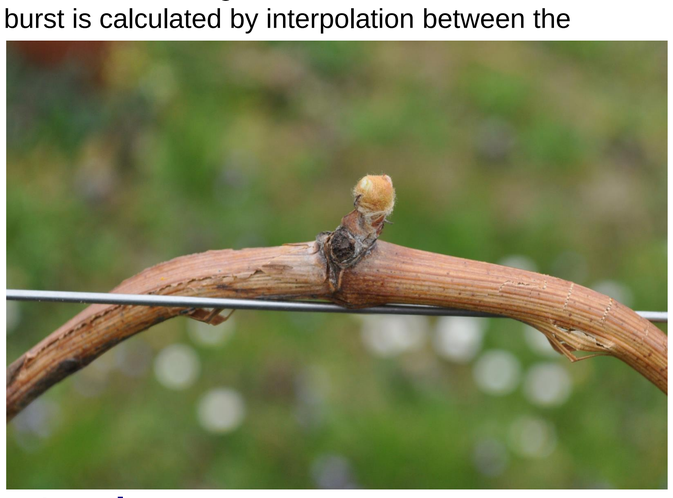
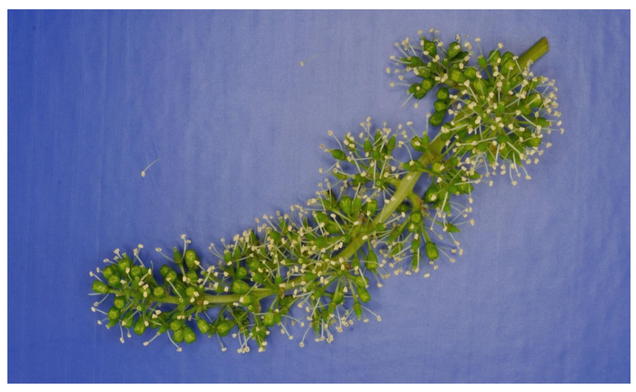


Figure 1: *Stage BBCH 07: green tip visible. Correspondences: Baggiolini: C, Modified E-L: 4*

Flowering, stage BBCH 65, is considered when 50% of the flowers are open (Figure 2). This corresponds to Baggiolini stage I and modified E-L stage 23.

- Only adult and productive plants with their final architecture are observed.
- A flower is considered as open when the base of the cap is detached, even is the cap has not fallen yet. A percentage of open flowers is visually estimated. The BBCH65 stage is the date when this percentage is 50%.
- Visual estimations on at least five plants are required.
- The entire plant is observed, not individual inflorescences.
- Observation frequency: first observation when a minimum of 5% and a maximum of 49% of the flowers are open. At least one more recording is necessary in order to have a value between 51 and 99% of open flowers. The delay between two recordings should not exceed one week.
- The date when 50% of the flowers were open is calculated by interpolation between the recorded values
- Classes (Class 1 = 0 – 10% flowers open, 2 = 11 – 30%, 3 = 31 – 50%, 4 = 51 – 80%, 5 > 80%) can also be used. The calculated BBCH 65 date corresponds in this case to class 3.4.

Figure 2: *Picture of Cabernet-Sauvignon in Colmar with 54% of open flowers. Open and closed flowers were manually counted.*



Test and validation of the protocols

For **budburst,** Intercalibration was carried out by a panel of 15 people on 8 April 2014 in a Bordeaux vineyard, France. This work consisted of bud ratings, conducted on 3 varieties (early and late varieties): *Vitis vinifera* cv. Roussanne, Mourvedre and Cabernet-Sauvignon, grown with 5 replicates for each variety on a single plot (gravelly soil) and grafted on the same rootstock (SO4). Observations were carried out on batches of five vines. The total number of main buds was counted for each batch (eyes of the crown were not taken into account). Total number of buds reaching stage BBCH 07 or more were counted. Percentage of buds reaching BBCH 07 or more were calculated for each observer and each batch.

Table 1: *Estimation of the percentage of buds reaching stage BBCH 07 around budburst in a Bordeaux vineyard for three varieties. Averages are counts from a panel of 15 assessors.*

Variety	Total number of buds per batch			Number of buds at stage BBCH 07 or beyond			Percentage of buds at stage BBCH 07 (%)		
	Mean	SD (1)	CV (2)	Mean	SD	CV	Mean	SD	CV
Cabernet-sauvignon	29.2	2.9	10.0	18.6	2.5	13.4	58.0	6.7	11.5
Mourvèdre	32.1	2.9	9.0	14.4	2.0	13.7	38.9	7.0	18.0
Roussanne	30.0	2.2	7.4	28.5	2.1	7.5	84.4	3.3	3.9

(1) Standard deviation (2) Coefficient of variation (%)

Total bud counts per vine were highly reproductive among panel members. Inclusion of crown buds was the main cause of miscounts. Counts of buds at stage BBCH 07 or more were also reproductive among panel members. Coefficient of variation for the percentage of buds at least at stage BBCH 07 varies from 4 to 18%. **Error in estimation of the date when 50% of the buds were at stage BBCH 07 was around one day.**

Assessment of the percentage of open flowers

Figure 2 shows an example of digital picture of a flowering bunch. The percentages of open flowers was counted on 15 inflorescences. They adequately covered the range 1-100%. Estimates were clearly higher compared to the real percentage of open flowers, especially in the 40-60% range (Figure 3). **Mean visual estimation of 50% open flowers actually ranged between 20 and 35 %**. This discrepancy can lead to an anticipation of the 50% flowering stage estimate, but is general for all the asse

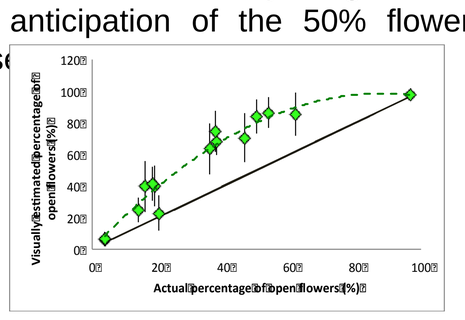
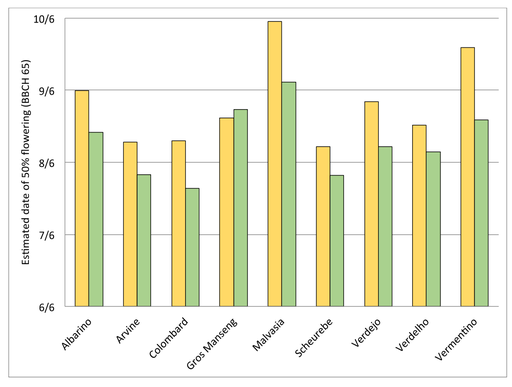


Figure 3 : *Comparison between the real percentage of open flowers and the visually estimated percentage of open flowers on Cabernet-Sauvignon. Bars represent standard-errors (n = 11).*

Assessment of flowering on whole plants or inflorescence by inflorescence

The assessment of flowering on whole plants generally led to slightly earlier dates of 50% flowering compared to assessments carried out inflorescence by inflorescence (Figure 4). However the difference was always lower than one day and can be neglected. **Estimates based on whole plants should be preferred because they are easier to implement.**

Figure 4: *Estimated dates of 50% flowering with two methods: inflorescence by inflorescence on 100 inflorescences (yellow) or by entire plants (green).*



Conclusion

Accurate recordings of major phenological stages are important for implementing management strategies and for assessing short or long term effects of climatic variability on grapevines. Widely accepted common protocols can help to avoid discrepancies in phenology recordings due to variations in observation or sampling strategies. The protocols proposed here for budbreak and flowering observations in grapevine are the result of a large consultation among viticultural researchers in the framework of the PERPHECLIM ACCAF project. The same approach is underway for the assessment of veraison dates.

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