Techniques for the assessment of grapevine bud fruitfulness: an overview

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Introduction and aim

In grapevine, fruit formation is a long and complex mechanism that begins before observation the inflorescences in the shoot. This mechanism begins with the initiation of the inflorescences primordia (IP) followed by flower initiation and differentiation, a process that extends over two growing seasons. The number of inflorescence primordia established during floral initiation determines the potential number of clusters that will form in the following growing season.

Bud fruitfulness represents the first measure of productive potential and provide an estimate the potential yield for the following season. Estimate the fruitfulness of dormant buds by counting the number of inflorescence primordia formed, regardless of their budding capacity under field conditions. Anticipated knowledge will serve as a support tool for decision making and management by the wine sector, especially in defining the load to be left to pruning, to achieve the desired production and avoid annual fluctuations.

Therefore, we intend to overview these techniques of fruitfulness analysis, their advantages and limitations, and their contribution to predicting yield potential. In this context, three Portuguese white varieties, Alvarinho, Fernão-Pires and Loureiro were used.

Figure 1: a) Dormant bud during dormancy period in field. **b)** Longitudinal section of dormant bud for fruitfulness assessment

Factors affecting induction and flower formation

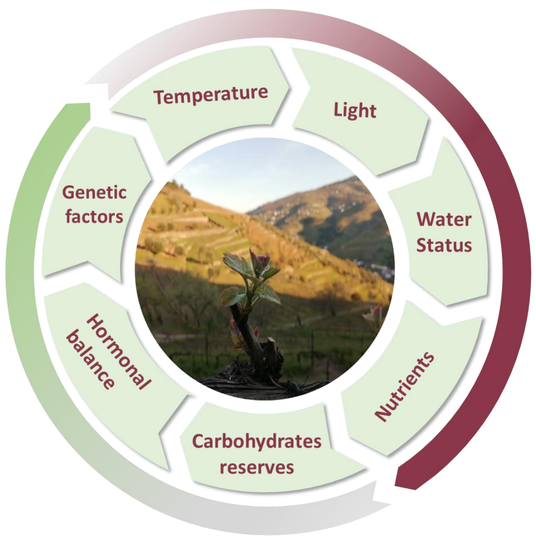

Figure 2: Environmental and endogenous factors affecting the initiation and differentiation of inflorescence primordia involved in yield variation.

The vineyard yield is not the same over the years and may vary as a result of a set of factors that influence the formation and development of reproductive structures.

Many studies have focused on the factors that directly and indirectly influence this mechanism, and on the way, they affect the greater or lesser fertility of the buds. Temperature, light intensity, nutrients availability and water status of the plant are the environmental factors that most influence this process (Figure 2).

On the other hand, endogenous factors such as hormonal balance, carbohydrate reserves, and genetic factors equally way have an important contribution. During induction and differentiation of IP, when receiving these favourable stimuli, it will promote the formation of inflorescence beginnings. In turn, an imbalance between the factors involved may compromise the formation and differentiation of inflorescences. This situation leads to losses in the fruitful buds and, consequently in the yield.

Methods for assessing grapevine bud fruitfulness

During dormancy, it is difficult to identify and quantify the bud fruitfulness, requiring the use of specific laboratory techniques and procedures. In addition, these methodologies allow to analyze the bud viability, namely, to diagnose possible necrosis in the tissues and to evaluate the extent of the lesion in the tissue. In this sense, we present three different methods used to determine the fertility of buds during winter dormancy.

Bud dissection analysis

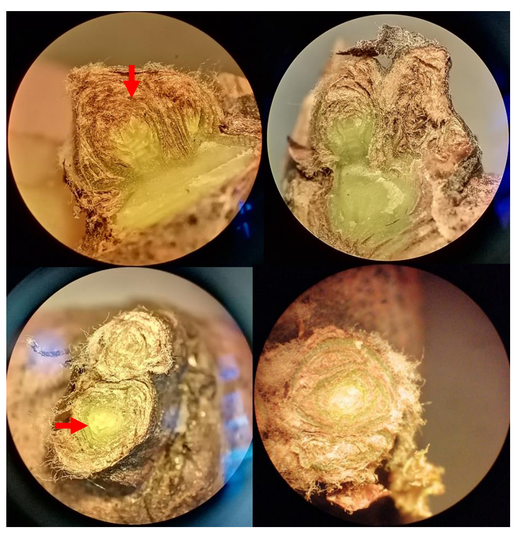

Figure 3: Longitudinal section of bud tissue observed under a stereomicroscope at 20× magnification. IP (red arrow)

- ✓ Uses a stereomicroscope supported by tweezers and a scalpel blade
- ✓ it is a time-consuming procedure, which requires a lot of care to avoid damaging the structure as the cuts.
- ✓ The information is immediately available after the anatomical cut of the bud.
- ✓ The fragility of the primordia and the meristems and the difficulty in removing the epidermal hairs that line these structures and hinder visualization are the major problems.
- ✓ Required a good knowledge of the bud anatomy for identification of all structures and primordia.

Histological analysis

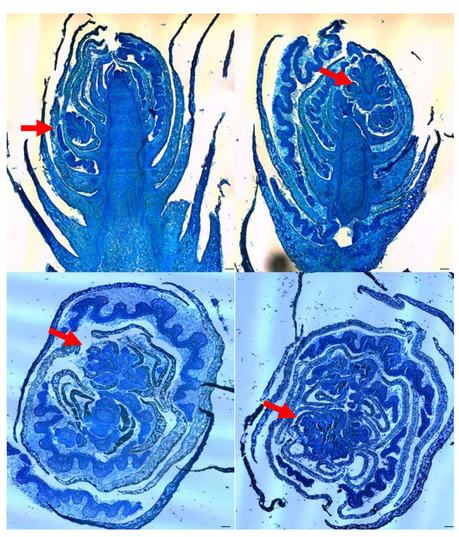

Figure 4: Longitudinal section of a dormant bud (Fernão-Pires variety) observed under a light microscope. (4x). IP (red arrow)

- ✓ Buds are embedded in paraffin wax, sectioned, stained and observed under an optical microscope.
- ✓ Scales and epidemical hairs are removed to allow the fixatives solutions and paraffin wax to act and preserve the entire structure.
- ✓ Bud cuts must be made in series to guarantee the visualization of all the inflorescence primordia.
- ✓ It is a time-consuming technique and requires equipment and reagents at higher costs.
- ✓ Required a good knowledge of the bud anatomy for identification of all structures and primordia

Forced bud growth under controlled environmental conditions

Figure 5: Development of inflorescences after budburst in the growth chamber of the varieties Alvarinho, Fernão-Pires and Loureiro varieties. IP (red arrow)

- ✓ Use cane wood containing one or more dormant buds, and subjecting them to controlled conditions of temperature, relative humidity, irradiance and photoperiod to induce the budburst.
- ✓ After budburst, fruitfulness is determined by simple visual observation and counting the number of inflorescences in the young shoot.
- ✓ The results are not immediate, as is necessary to wait for the development and visualization of inflorescences
- ✓ Low percentage budburst and fruitfulness of the base buds in some varieties

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