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Defoliation of the vines before or after berry set: Physiological consequences and qualitative factors

>>> Defoliation of the vines consists of eliminating the leaves in the grape bunch zone in a more or less intensive manner. It is a long-proven prophylactic technique that has seen a renewed interest in the current context of the reduction of phytosanitary inputs. However, several questions remain. Which is the optimal period? What is the ideal intensity? What are the risks? Is the mechanization of this process a feasible option? Agroscope has been undertaking defoliation trials in Switzerland since 2010 in order to shed light on these questions. <<<

Study context

The choice of defoliation timing must be undertaken judiciously in regards to the desired results. Effectively, the elimination of adult leaves in full photosynthetic activity will reduce the carbon uptake toward the inflorescences or the bunches at a period that could be critical for the balanced nutrition of the vine and a good ripening of the grapes. The Agroscope research station has set up defoliation trials on five grape varieties – Chasselas, Doral, Pinot noir, Gamay and Merlot – and in three experimental sites in the Lake Geneva region as well as in the Tessin region (South of the Alps). Three defoliation periods were tested – Phenological stage BBCH 57 (separated flower buds) 67 (end of flowering) 77 (bunch closure) – compared to a non-defoliated control test.

Also tested was the intensity of the defoliation on Chasselas 50 % or 100 % of the grape bunch zone. The reference articles cited present the trials in a detailed manner[3,4,5,6].

Between berry set and veraison (colour change): «Classical » defoliation

The defoliation of the grape bunch zone is generally undertaken during the period of the formation of the bunches – after the berry set and before the veraison (color change) – while the vine is still in its growth phase. It permits the creation of a ventilated microclimate around the grapes so as to efficiently prevent the development of fungal diseases, notably powdery mildew (*Erysiphe necator*) and grey rot (*Botrytis cinerea*). It otherwise fosters a better penetration of phytosanitary products. More the defoliation is intensive (100 % in the context of this study) in the grape bunch zone, more it is efficient in combating fungal diseases[5].

Defoliation after berry-set does not affect the harvest yield and has little influence on the composition of the grape must insofar as the leaf-to-fruit ratio – a critical criterion in ensuring the ripeness of the grape – is maintained above 1 m^2 of exposed canopy per kilogram of harvest.

Defoliated Chasselas

A strong compensation capacity

Defoliation creates a strong competition between the vegetative and reproductive organs. The vines must then draw from their reserves, that could effectively lead to a lower vigor and fertility in the long term. An intensive defoliation is, therefore, not recommended on vines that are either too young or have a low vigor. The long-term durability of the vines did not seem to be affected in the context of this study.

After veraison, defoliation is not generally recommended, exposing a risk of slowing the maturation of the grapes and increasing the berry sunburn symptoms. A late defoliation undertaken just before the harvest, presents the sole interest of gaining time during the harvest, estimated at 20-30 % on the scale of the plot (CIVC, 2019).

Before berry set: pre-floral defoliation or « early »

Pre-floral defoliation presents important consequences on the rate and level of the berry set. A defoliation that is effectuated very early (stage of separated flower buds) and intensively (100 % of the bunch zone at the level of six leaves including the lateral shoots) such as realized in the context of these trials, systematically brings a yield reduction that can reach 40 %, regardless of the vintage, the grape variety or the yield potential[3,4,5].

Even if the lower yield would contribute to limiting the green harvesting work, the pre-floral defoliation must be, therefore, applied in a reasoned and parsimonious manner so as to avoid excessive yield loss. That being said, the impact of defoliation on the yield can be easily adjusted by the intensity of the operation[5]. Furthermore, pre-floral defoliation presents the advantage of considerably reducing the risk of berry sunburn.

Defoliation at the moment of the bunch closure resulted in increased symptoms of berry sunburn, whereas the defoliated variant during the flowering period showed

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intermediary results. In short, the earlier the defoliation, lesser are the berry sunburn symptoms[6]. In fact, the bunches are exposed to sunlight in a period that is often cooler than in high summer. Furthermore, the bunch structure is significantly modified: fewer berries, with thicker skins[4,5] (figure 1), more resistant and richer in polyphenols with an antioxidant role.

Quality of the musts and the wines

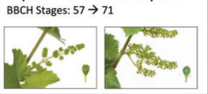
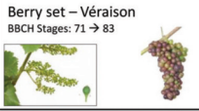
The impact of defoliation on the composition of the grape must varied mostly depending on the grape variety. The maturity (sugars, acids) of the musts at harvest – above all determined by the weather conditions of the vintage – did not vary as a function of the defoliation period. Only the variant that was not defoliated emerged with a higher acidity in certain years (Pinot noir, Merlot)[6].

All the same, the pre-floral defoliation helped the accumulation of the polyphenols in the grape skin and thus improved the color and the stability of the red wines[4]. The Pinot noir wines were considerably improved through the practice of pre-floral defoliation: better bouquet, better structure on the palate, better overall impression. The Merlot wines were improved in certain years and the Gamay wines – a grape variety with greater plasticity – were minimally impacted. The quality and typicity of the white wines (Chasselas and Doral) were not modified, regardless of the defoliation period, most probably because the wines were vinified after the direct pressing without any skin contact maceration[3,5]. Pre-floral defoliation had no adverse effect on the wines.

Mechanical defoliation

The mechanization of defoliation is common practice and economically advantageous. The different techniques of mechanical defoliation are presented in a very comprehensive study (IFV, 2009)[1]. The mechanization of pre-floral defoliation is feasible with the pneumatic-type leaf-thinner. The first results of the trials that have been undertaken since 2016 on Gamay and Doral grape varieties are interesting. Usually undertaken after the flowering period, the passage of the machine can, in fact, be realized before the flowering, once the lifting work has finished. The pre-floral mechanical defoliation induces a reduction in the yield – lower rate of berry-set and loss of flower buds – and seems to have the same impact on the quality of the must in comparison to a manual pre-floral defoliation.

Table 1. Defoliation periods and their consequences. Extreme negative effect (- -), negative (-), neutral (0), positive (+), very positive (+ +)[2]

Defoliation period	Healthy state	Yield	Time saving at harvest	Quality of musts and wines
Separated buds – berry set BBCH Stages: 57 → 71 	+ +	- - / - As a function of defoliation intensity	+	- / + + Depending on grape variety and weather conditions
Berry set – Véraison BBCH Stages: 71 → 83 	+ +	- / 0	+	- / + Depending on grape variety and weather conditions
After véraison BBCH Stages: 83 → 89	+	0	+	- / 0 The leaf-fruit relation must remain sufficient
Just before harvest BBCH Stage: 89	0	0	+ + Targeted Defoliation on the bunches	0

The pre-floral defoliation affects the structure of the berries.

The berry size is often smaller following a pre-floral defoliation. Furthermore, the thickness of the skin increases significantly. The resulting skin-pulp relationship has an impact on the composition of the musts at harvest.

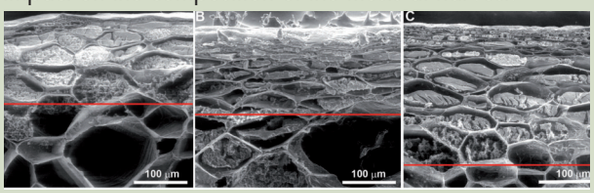


Figure 1. Cross sections of the Chasselas grape skins just before the harvest shows the effect of the defoliation period on grape skin thickness. The red line defines the limit between the skin cells (above) and the pulp cells (below). A: Non-defoliated variant; B: Classical defoliation at the bunch closure stage; C: Pre-floral defoliation at the separated flower bud stage. Trials on Chasselas, Pully 2015[5]. Images effectuated by an electronic microscope (Environmental scanning electron microscopy, ESEM).

Conclusion

Despite the variability of its impact – principally linked to the climate and the grape variety – the practice of defoliation before the veraison systematically produced positive results in the battle against fungal diseases on the vines and on the grape composition. This study, undertaken on five grape varieties in the regional context of Switzerland thus confirms the majority of the results obtained on other grape varieties and in different soil and weather conditions (table 1). If it is realized earlier, just after the berry set, it reduces the risk of berry sunburn. To the extent that a lower yield is sought, the pre-floral defoliation, when practiced in a reasoned manner, is a useful prophylactic practice for managing the yield, increasing the resistance to pathogens and improving the polyphenol content of the musts at harvest. ■

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