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*Original Citation:*

*Availability:*

This version is available <http://hdl.handle.net/2318/1868858> since 2022-07-09T09:00:54Z

*Publisher:*

International Viticulture and Enology Society

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## Bunch placement effects on dehydration kinetics and physico-chemical composition of Nebbiolo grapes

Sforzato di Valtellina DOCG is a special reinforced red wine produced using withered Nebbiolo grapes. The withering process takes place in traditional rooms under natural environmental conditions; it starts immediately after the harvest and ends not before the 1st December of the same year. The process can be performed with different bunch placements that can influence the grapes features. The purpose of the study is to compare the effect on grape physico-chemical parameters for four withering bunch placement systems: hanged clusters (HC), plastic crates (CT), breathable mesh fabric on wooden frames panels (MF), and reed mats (RM). For all the systems studied, the withering length was two months at a temperature between 6 and 19 °C and a relative humidity of 41-88%. The grapes were sampled at the beginning, at half time, and at the end of withering. For each sampling point, weight loss rate, skins mechanical properties (i.e. hardness and thickness), must technological parameters, and skins and seeds extractable polyphenols, flavonoids, anthocyanins, and condensed tannins were studied. At the end of withering, the berry weight loss resulted very different among the systems, ranging from 18.79 to 12.73%. HC showed the fastest weight loss, followed by MF, CT, and RM. Interestingly, the dehydration kinetics showed different trends over the process: for HC the rate of weight loss (WLR, %/day) resulted higher in the first half of the process and then decreased; on the contrary, the kinetics of CT and MF were slower at the beginning of withering compared with the second phase; for RM, instead, the WLR remained fairly constant throughout the entire period. These differences yielded different consequences on the complex balance between concentration-synthesis and loss of compounds during withering. HC led to a significantly higher sugar content than the others after two months of withering. Instead, no significant differences were found among the systems for total acidity, pH, acetic acid, and glycerol (markers of microbial development), and mechanical properties. As regards phenolics, RM led to a significant reduction in skin extractable polyphenols and flavonoids when expressed as mg/kg berries, possibly because the lower concentration effect did not exceed the greater loss of these compounds compared to the other placements. No significant differences were found among systems in seeds polyphenols. In conclusion, under the same environmental conditions bunch placement influenced weight loss, dehydration kinetics, skins polyphenols, and to a lesser extent also the sugar content. The best compromise between weight loss and grape features seems to be the use of plastic crates, whereas hanged clusters placement allowed to achieve the same weight loss faster, although resulting in a higher sugar content. Therefore, these results can provide knowledge to choose the withering system with awareness according to the established oenological objective.

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**Keywords:** bunch placement, grape dehydration, weight loss rate, physico-chemical parameters, special wines



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