BERRY WEIGHT LOSS IN *VITIS VINIFERA* (L.) CULTIVARS DURING RIPENING

Authors:Erna BLANQUAERT[1*], Markus KELLER[2]

(1) Department of Viticulture and Oenology, Stellenbosch University, Private Bag X1, Matieland7602, South Africa

(2) Irrigated Agricultural Research and Extension Center, Washington State University, 24106 N. Bunn Road, Prosser, WA99350

*Corresponding author: ewitbooi@sun.ac.za

Abstract: Context and purpose of the study – Berry shriveling (BS) in vineyards are caused by numerous factors such as sunburn, dehydration, stem necrosis. Climate change results in an increase in day and night temperatures, rainfall throughout the year, changes in the timing and quantities, long dry summers and a combination of climatic variability such as floods, droughts and heatwaves). Grape development and its composition at harvest is influenced by the latter as grape metabolites are sensitive to the environmental conditions. The grape berry experiences water loss and an increase in flavour development as a result of the BS. An increased sugar content ingrapeswillresultinhigher alcoholwinesandconcentrationofgrapearomaswhichmaybedetrimentaltothe final wine quality. More so, crop estimations are negatively impacted as a result of BS which results in lower compensation for grape producers. This pilot study seeked to investigate the berry weight loss in twelve *Vitis vinifera* (L.) cultivars in WashingtonState.

Material and methods – This study was conducted during the 2018 growing seasons at the Washington State University (WSU) Irrigated Agriculture Research and Extension Center (IAREC) in Prosser, Washington, USA (46°17'N; 119°44'W; 365 m a.s.l.). The vineyard contained 30 wine grape cultivars (*Vitis vinifera*) separated into 16mainblocksof13rowseachalongwithbordersectionsof5vineseach.Allvineswereplantedataspacingofm × 2.7 m (2058 vines/hectare). Grape cultivars were separated into groups of either white or red, with all vines planted in a north-south orientation using the Vertical Shoot Positioned (VSP) training system.Each of the 16mainblockswasdedicatedtooneoffourmaincultivars;Merlot,CabernetSauvignon,Chardonnay,orRiesling. Border sections containing the additional 26 cultivars were located on the southern, eastern, and western portionsofthevineyard.Eachborder cultivar sectionconsistedofthreeorfourrepetitionsoffivevineseach.All weather data was gathered from the Roza automated weather station and the WSU AgWeatherNet system (AgWeatherNet2018).Berryfreshweightandtotalsolublesolidsweredeterminedjust aftervéraisonthroughout berrydevelopment.

Results – In this study on weight loss in ripening white (Chardonnay, Weisser Riesling, Gewurztraminer, Alvarinho, Muscat blanc and Sémillon) and red grape cultivars (Cabernet Sauvignon, Merlot noir, Grenache, Lemberger, Malbec, Cabernet franc) ripening curves of non-solutes per berry (mostly water) were similar to the berry weight curves. Solutes per berry (mostly sugar) increased to a maximum berry weight for most of the cultivars. Prior to véraison phloem sap is the only source for water and solutes that enter grape berries until maximum berry weight followed by a decrease in the solutes per berry. Later during the ripening stage berry shrinking occurred due to elevated transpiration, which resulted in an increase in ˚Brix (solutes). Grape cultivar, environmental and cultivation practices have an impact on the concentration of berry of solutes, which dictates the composition and will have an impact on the wine quality. However, this study needs to be repeated and the wine quality should be assessed.

Keywords: grape berry, berry weight, berry shrinkage

1. Introduction.

Berry weight loss in wine grape cultivars during ripening

BLANCQUAERT, E.H [1] & KELLER, M [2]
email: ewitbooi@sun.ac.za

1. Department of Viticulture and Oenology, Stellenbosch University, Private Bag X1, Matieland, 7602, South Africa.
2. Irrigated Agriculture Research and Extension Center, Washington State University, 24106 N. Bunn Road, Prosser, WA 99350

Viticulture and Oenology
STELLENBOSCH UNIVERSITY

INTRODUCTION & OBJECTIVE

Water scarcity and increasing daily temperatures have a detrimental effect on wine grape production. Over the past vintages more so than previously. Climate change results in an increase in day and night temperatures, the rainfall throughout the year, changes in the timing and quantities, long dry summers and a combination of climatic variability such as floods, droughts and heatwaves) and an increase in extreme events like hail storms and gale force winds. Grapevine phenology (growing cycles) is therefore much earlier compared to a decade ago. Grape development and it's composition at harvest is influenced by the prevailing weather conditions. Grape ripening is multi-faceted as it includes numerous physical and biochemical modifications (Jackson & Lombard, 1993; Le Moigne et al., 2008; Dai et al., 2010; Deloire, 2013). Therefore, grape producers are faced with a crop that diminishes in yield and quality due to increasing climate change. This study aimed to investigate berry weight loss in twelve *Vitis vinifera* L. cultivars in Washington State, United States was monitored throughout the season.

MATERIALS AND METHODS

- This study was conducted during the 2018 growing season at the Washington State University Irrigated Agriculture Research and Extension Center in Prosser, Washington, USA (46°17'N; 119°44'W;365 m a.s.l).
- Six white cultivars (Alvarinho, Chardonnay, Gewürztraminer, Muscat blanc, Riesling, Sémillon) and six red cultivars (Cabernet franc, Cabernet Sauvignon, Grenache, Lemberger, Malbec, Merlot) were used in this study.
- Chardonnay, Riesling, Merlot and Cabernet Sauvignon are divided in four blocks (repetitions) and the border sections containing the additional 26 cultivars were located on the southern, eastern, and western portions of the vineyard. Each border cultivar section consisted of three repetitions of five vines each.
- All vines were planted in 2010 at a spacing of 1.8 m X 2.7 m in a north-south orientation, spur-pruned and trained using vertical shoot positioning.
- Berry fresh weight and total soluble solids were determined just after véraison and throughout ripening. Twenty berries were sampled from each repetition weighed individually and the Brix determined with an ATAGO PAL-1 pocket refractometer (Tokyo, Japan) determined after sampling.
- Solutes per berry (g) = berry weight x °Brix/100 , Non-solutes per berry (g) = berry weight – solutes per berry and rate of weight loss (mg/d) = (maximum berry weight – final berry weight)/time (number of days from maximum weight to final weight was calculated.
- Statistica 13.5 was used to construct two-way ANOVA's.

RESULTS

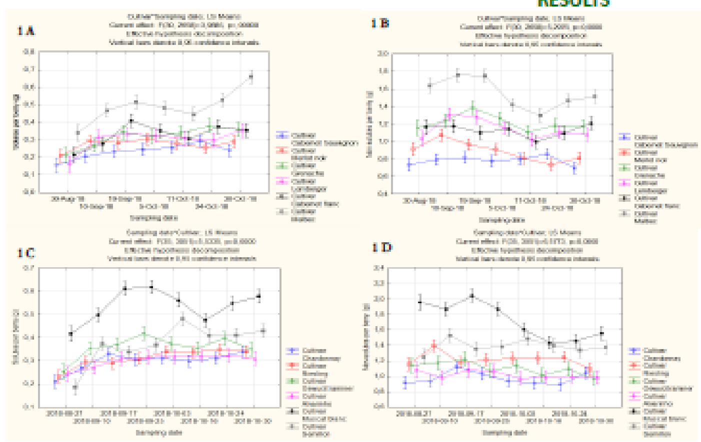

Figure 1. (a &b) Solute accumulation and non-solute decrease in red cultivars. (c &) Solute accumulation non-solute decrease in white cultivars.

Table 1. Rate of berry weight loss (mg/day) of red cultivars in 2018.

Cultivar	Rate of berry weight loss (mg/day)
Cabernet Sauvignon	35,6
Merlot noir	5,36
Grenache	4,85
Lemberger	3,7
Cabernet franc	2,26
Malbec	13,82

Table 2. Rate of berry weight loss (mg/day) of white cultivars in 2018.

Cultivar	Rate of berry weight loss (mg/day)
Chardonnay	1,54
Riesling	5,24
Gewurztraminer	6,31
Alvarinho	2,18
Muscat blanc	11,78
Semillon	6,00

DISCUSSION

- Solutes (hexose sugars, malate, tartrate and potassium ions) accumulated in the berries in both the white and red cultivars (Figure 1a& 1c) until a maximum berry weight is reached.
- Thereafter a lower rate of solute accumulation is observed with the exception of Muscat blanc and Malbec
- Non-solutes (primarily water and small amounts of cellulose and non-water soluble compounds) (Figure 1b & 1d) were similar to the berry weight curves (data not shown).
- A decline in berry weight as berries shrink is most readily as a result of water loss, cuticular conductance and the Vapour Pressure Deficit (VPD) demand.
- Berry weight loss per day (Table 1 & Table 2) reported in this study corresponds with that of other studies (McCarthy & Coombe, 1999, Perez, 2016), but could also be as a result of crop load which if too high can result in delayed maturity and an imbalance in the fruit-weight:leaf area ratio.

CONCLUSION

- Berry weight loss (dehydration) is based on cuticular conductance and the Vapour Pressure Deficit (VPD) which prevails later in the growing season.
- Delaying harvest will result in an increase in solute concentrations which will result in high alcohol wines and unbalanced wines.
- Profitability of grape producers will be affected (lower prices per ton of grapes).
- With increasing temperatures an in-depth study focusing on berry transpiration, cuticular conductance, organic acid content and sugars are needed.

REFERENCES

- Chen, H., Šuklje, K., Antalick, G., Schmidtke, L.M. & Blackman, J.W., 2018. Late-Season Shiraz Berry Dehydration That Alters Composition and Sensory Traits of Wine. J. Agric. Food Chem. 66 (29), 7750-7757.
- Dai, Z.W., Vivin, P., Ollat, N., Barrieu, F. & Génard, M., 2010. Physiological and modelling approaches to understand water and carbon fluxes in relation with grape berry growth and quality. Aust. J. Grape Wine Res. 16, 70-85.
- Deloire, A.J., 2013. Berry ripening and wine aroma. Practical Winery and Vineyard, April, 1-3.
- Jackson, D.I. & Lombard, P.B., 1993. Environmental management practices affecting grape composition and wine quality – A review. Am. J. Enol. Vitic. 44, 409-430.
- Le Moigne, M., Symoneaux, R. & Jourjon, F., 2008. How to follow grape maturity for wine professionals with seasonal judge training? Food Qual. Prefer. 19, 672-681.
- Šuklje, K., Zhang, X., Antalick, G., Clark, A.C., Deloire, A. & Schmidtke, L.M., 2016. Berry shriveling significantly alters Shiraz (Vitis vinifera L.) grape and wine chemical composition. J. Agric. Food Chem. 64, 870-880.
- McCarthy, M.G., Coombe, B.G., 1999. Is weight loss in ripening grape berries cv. Shiraz caused by impeded phloem transport? Australian Journal of Grape and Wine Research, 5, 1, 17-21.
- Perez, J.C., 2016. Defining wine grape weight loss. MSc Thesis, Washington State University

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