SEAS (Sustainable Environment Agricultural Science) **E-ISSN 2614-0934**
http://ejournal.warmadewa.ac.id/index.php/seas
Volume 07, Numer 02, October 2023, Pages:139~144 http://dx.doi.org/10.22225/seas.7.2.8222.139-144

Productivity and Brix value of Green Grapes *(Vitis vinifera L var. Muscat Saint Vallier) at Different Location and Pruning Time* in Buleleng Bali

Luh Putu Yuni Widyastuti [1*], Ni Kadek Ema Sustia Dewi [2]
[1]Agrotechnology Study Program, Faculty of Agriculture and Business, Universitas Mahasaraswati Denpasar, Denpasar, Indonesia
[2]Agrotechnology Study Program, Faculty of Agriculture, Universitas Pembangunan Nasional Veteran Yogyakarta, Yogyakarta, Indonesia

*Corresponding author. Email: Widyastutyyuni@unmas.ac.id

Abstract

Bali is one of the grape-producing regions in Indonesia, and grape cultivation is carried out in the North Bali area of Buleleng Regency. Grape growers in Bali began to plant other grape varieties, namely green grapes (Vitis vinifera L. var. Muscat Saint Vallier). This grape variety originates from France and grows successfully in the tropics.There needs to be more information about the yield potential and quality of green grape varieties. This study aims to determine the productivity and quality of green grapes at several harvest periods and locations. The research was conducted from January 2021 to September 2022 at three sub-district locations: Gerokgak, Kalisada, and Seririt. The research was conducted at six locations, namely Gerokgak 1, Gerokgak 2, Gerokgak 3, Kalisada 1, Kalisada 2, and Seririt. Data collection was carried out during three pruning to harvest periods: January–March, April–June, and July–September. Harvest period and planting location show a significant influence on green grape productivity. Observations on grape productivity in different years showed no significant results, and interaction between location and harvest period. The harvest period for two consecutive years shows that the July–September harvest period gives the best yields. The quality of the yield of green grapes shown in the fruit ^{o}brix at both locations at different harvest periods shows that the ^{o}brix of this variety remains the same.

Keyword: Fruit quality, green grapes, harvest period, productivity

1. Introduction

Grape is the fifth most-produced fruit, with approximately 79.5 million tons produced worldwide in 2019 [25]. Bali is one of the grape-growing regions in Indonesia. The cultivation of vineyards is carried out in the northern Bali area of Buleleng district, located in several districts of Gerokgak, Banjar, and Seririt [18]. According to [3], the three districts recorded as grapes producers in 2021 are the district of Gerokgak with 5,829.46 tons (57.19 percent), the district of Seririt with 2,383.97 tons (23.39 percent), and the district of Banjar with 1,980.11 tons (19.43 percent). Vines have been planted on the northern coast of East Java and Bali at an altitude of about 5-300 metres above sea level.

The high levels of vitamins in the grape lead to high public purchasing ability, but it is not offset by adequate grape production. Grape has plant metabolite concentrations with high antioxidant activity, including polyphenols such as flavonoids, tannins, resveratrol, and anthocyanins [10]. The vine planting pattern used in Buleleng is the pergola planting pattern, which is a building on top of which there are para-paras for vines such as grapes as shade, which are supported by poles row.[21].

The vineyard's behaviour in tropical environments is very different from that observed in temperate climatic regions [4][11]. Through proper irrigation, cutting, and management, it can obtain

twice the harvest per year [14]. Grapes produced in tropical climates with varying altitudes, rainfall distribution, and temperature variations suitable to the seasons in a year have made it possible to be unique and have great potential for grape production for wine[22].

Grape farmers in Buleleng dominate the cultivation of the Bali black grape (Vitis vinifera L. var. Alphonso Lavelle). However, currently, grape farmers in Bali are starting to plant other grape varieties, one of which is green grapes (Vitis vinifera L. var. Muscat Saint Vallier). This type of grape has a fruit with a green colour and belongs to the white variety (a variety of white grapes). It has sweeter fruit meat than Bali black wine (Vitis vinifera L. var Alphonso Lavelle). This variety of grape originates in France and successfully grows in the tropics. This variety has a high yield potential, having a total soluble solidity potential (°brix) of 21.60 [24]. Green grape (Vitis vinifera L. var. Muscat Saint Vallier) is now widely cultivated by farmers and sold as a raw material for making wine. Tropical grapes are already grown in Thailand, Brazil, and Venezuela and can be produced twice or three times a year, depending on the grape variety grown. Indonesia also has great potential to develop several grape varieties that can be harvested two to three times [6].

Currently, there needs to be more information about the potential yield and quality of green grape varieties cultivated in Indonesia. (Vitis vinifera L. var. Muscat Saint Vallier).This grape variety appears to have good disease resistance, is able to produce both in the tropics and can potentially be obsolete in the assembly of new white grape varieties in Indonesia. This study aims to determine the productivity and quality of green wine (Vitis vinifera L. var. Muscat Saint Vallier) at several harvest periods and garden locations.

2. Material and Methods

The study was conducted from January 2021 to September 2022. This experiment consists of two factors with a randomised complete block design (RCBD). The first factor is the six locations of the farm gardens: Gerokgak 1, Gerokzak 2, Gerokkak 3, Kalisada 1, Klisada 2, and Seririt. The second factor is the three pruning periods until harvest: January–March, April–June, and July–September. There are 18 combinations of treatments.

Data obtained from observations in the field based on grape productivity and analysis of fruit quality in the form of sweetness level (^{o}brix) was carried out directly in the field by taking five samples of fruit. The data gained was analysed using Ms. Excel and the STAR (Statistical Tool for Agricultural Research) program. Data were analysed using analysis of variance at the 5% level. If there was a significant influence, then continue with the Least Significance Different (LSD) test.

3. Results and Discussion

3.1 General condition of green grape production

The green grape (Vitis vinifera L. var. Muscat Saint Vallier) has a fruit of a green colour and belongs to the white variety (white grape variety). The average monthly rainfall from January 2021 to September 2022 of 167 mm falls is in the middle category, with an average monthly temperature of 27.9 °C. The grape ripening process involves both internal and external morphological and physiological processes such as nutrition, light, temperature, and water status [1] and [8]. Vineyards grown in tropical areas such as Indonesia have many challenges because tropical climates tend to have irregular rainfall patterns [15]. Therefore, the vineyards require good water management [5].

Figure 1. Growth of green grapes *Vitis vinifera* L var. Muscat Saint Vallier

3.2 Productivity of the Muscat Saint Vallier grape variety

Table 1 shows the prints of grapes showing a significant influence of the location on the productivity of the Muscat Saint Vallier grape varieties. In contrast, the harvest periods show a very significant influence on the production.

Table 1.
Anova of *Muscat Saint Vallier* green grape production

Source	DF	SS	MS	Fhit	P>f
Year	1	128.642	128.642	0.61 ns	0.4450
Loocatin	5	4.492.116	898.423	4.27 *	0.0107
Harvest period	2	8.385.895	4.192.947	19.93 **	0.0000
Locatin x harvest period Harvest	10	2.573.880	257.388	1.22 ns	0.3436
Error	17	3.577.047	210.415		
Total	35	19.157.580			

Nb: ns= not significant, * = significant F stat > F table level 5%, **= very significant F stat > F table level 1%.

Table 2 shows that the vineyards located at Gerokgak 2 are the site of the vineyards that produces the highest fruit yield of 16.12 tons/ha, and the vines located at Seririt produce the lowest fruit productivity of 6.70 tons/ha Observations from 2021 to 2022 show that planting at different locations yields different harvests. The difference in average productivity is quite significant, namely between 15.11 tons/ha and 6.70 tons/ha, more than 50%. Many factors cause differences in grape productivity and juice quality in these locations, one of which can be soil conditions as well as plant age at each location. Soil conditions and sufficient nutrient supplies are essential for grape yields and quality and the planting age of the grapevine significantly affects the available nutrients in the soil [26]. Observations show that the Muscat Saint green grape varieties have very diverse productivity and are likely to be influenced by soil conditions as well as plant age. The plant age in farm gardens ranges from 6 to 12 years. In addition, it is necessary to re-examine the decline in productivity as plants grow. The re-examine result will help farmers know when to regenerate plants.

Table 2.
Muscat Saint Vallier green grape productivity at six different vineyards location

Location	Productivity (tons/ha)	
Gerokgak 1	15.11	a
Gerokgak 2	16.12	a
Gerokgak 3	12.05	ab
Kalisada 1	9.47	b
Kalisada 2	7.82	b
Seririt	6.70	b

Nb: Numbers following with the same word not significant at LSD test

Observations carried out over three harvest periods for two consecutive years showed that the July to September harvest period gave the best yield, namely 16.23 tons/ha, followed by the January to March harvest period of 12.70 and 4.70 in April to June. It is known that the cycle from pruning to harvesting of grapes plant in Indonesia lasts only three months, whereas, in grapes planted in subtropical areas, the plants complete the period of growth to harvest for one year. The warm tropical climate allows grapes to be harvested three times a year. Research results [9] show that grapes planted at warmer temperatures will result in accelerated grape growth, such as bud growth, flowering, veraison, and harvest. According to [19], the main factors affecting grape cultivation are warm air, temperature, and water shortages, which will later affect the level of grape composition more than the result. Higher temperatures are able to increase the metabolic rate and influence some synthesis and accumulation of metabolites including secondary metabolites such as polyphenols and flavonoids such as anthocyanins and high temperatures accelerate the control of grapes, which causes a higher total dissolved solids (TSS) content [27].

Table 3.
Muscat Saint Vallier green grape on three different harvest periods

Harvest periode	Productivity (tons/ha)	
January-March	12.70	a
April-June	4.70	b
July-September	16.23	a

Nb: Numbers following with the same word not significant at LSD test

Productivity of green grapes for two years during the April-June harvest period results in low productivity, which is known to be the rainy season. In contrast, the January-March and July-September harvesting periods are the end of the drought season and rainy seasons. It shows that Muscat Saint-Vallier's green grape, to obtain good productivity, provides for particular rainfall and air temperatures.

Table 4.
^{o}Brix of *Muscat Saint Vallier* grape fruit at six different locations in 2022

Location	Fruit ^{o}brix
Gerokgak 1	16.86
Gerokgak 2	16.32
Gerokgak 3	16.8
Kalisada 1	18.3
Kalisada 2	17.58
Seririt	16.2

Nb: Numbers following with the same word not significant at LSD test

Tabel 5.
^{o}Brix of *Muscat Saint Vallier* grape fruit on three different harvest periods in 2022

Location	Fruit ^{o}brix
January-March	17.43
April-June	17.76
July-September	15.84

Nb: Numbers following with the same word not significant at LSD test

The estimated fruit ripeness is crucial to determining the right harvest time so that it will be in accordance with the desired results [16] [20]. It is also essential for grape production, where the growing length season, location, variety, and environmental conditions influence the fruit's optimal maturity point [7] and [13]. The quality of the green grape harvest shown on the fruit ºobrix in Table 4 for the location and Table 5 for the harvest period indicates that the test results are not significant, and the ºbrix of this fruit variety has mostly stayed the same. Based on the data, the fruit ºbrix obtained has yet to reach the desired value for producing good wine. The desired ºbrix value to obtain quality wine fermentation results is > 24.3. Pruning grapes will affect the harvest, and the same pruning technique will give different results for various grape varieties [12]; [17]; [14]. The short pruning to harvest period affects the ability of the vines to fully achieve the desired growth (sugar/acid ratio, grape flavour profile) to produce high-quality wine beverages [2].

4. Conclusion

Harvest periods and planting locations show a significant influence on the productivity of green grapes. The grape productivity observation in different years suggests no significant yields and no interaction between location and harvest period. The harvest period for two years in a row indicates that the period of harvest from July to September produces the best yield. The harvest quality of green grapes shown on the fruit obrix at the locations and different harvest periods indicates that the fruit obrix of this variety remains the same.

References

[1] Azuma, A. (2018). Genetic and environmental impacts on the biosynthesis of anthocyanins in grapes. *J. Hort*, 87, 1–17.

[2] Barnuud, N., Zerihun, A., Mpelasoka, F., Gibberd, M., Bates, B. (2014). Responses of grape berry anthocyanin and titratable acidity to the projected climate change across the Western Australian wine regions. *Int J Biomet*, 58:1279–1293.

[3] BPS Kabupaten Buleleng. (2021). Statistik hortikultura kabupaten buleleng 2021. Buleleng. BPS Kabupaten Buleleng.

[4] Carbonneau, A. (2010). Tropical viticulture: Specificities and challenges for a quality viticulture. *II International Symposium on Tropical Wines*.

[5] da Silva, J.R., Rodrigues, W.P., Ferreira, L.S., de P Bernado W., Paixão, J.S., Patterson, A.E., Ruas, K.F., Viana, L.J., de Sousa, E.F., Bressan-Smith, R.E., Poni S., Griffin, K.L., Campostrini, E. (2018). Deficit irrigation and transparent plastic covers can save water and improve grapevine cultivation in the tropics. *Agricultural Water Management*, 202, 66–80.

[6] Demir, K.O.K. (2014). A Review on Grape Growing in Tropical Regions. *Turkish Journal of Agricultural and Natural Sciences Special Issue*, 1, 1236-1241.

[7] Drappier, J., Thibon, C., Rabot, A., Geny-Denis, L. (2017). Relationship between wine composition and temperature: Impact on Bordeaux wine typicity in the context of global warming—Review. *Crit. Rev. Food Sci*, Nutr, 59, 14–30.

[8] Gao-Takai, M., Katayama-Ikegami, A., Nakano, S., Matsuda, K., Motosugi, H. (2017). Vegetative growth and fruit quality of Ruby Roman grapevines grafted on two species of rootstock and their tetraploids. *J Hort*, 86, 171–182.

[9] Hall, A., Mathews, A.J., Holzapfel, B.P. (2016). Potential effect of atmospheric warming on grapevine phenology and post-harvest heat accumulation across a range of climates. *Int J Biometeorol*, 60, 1405–1422. DOI 10.1007/s00484-016-1133-z

[10] Halliwell, B., Gutteridge, J.M. (2015). Free Radicals in Biology and Medicine; New York. Oxford University Press.

[11] Jogaiah, S., Oulkar, D.P., Vijapure, A.N., Maske, S.R., Sharma, A.K., Somkuwar, R.G., (2013). Influences of canopy management practices on fruit composition of wine grape cultivars grown in semi-arid tropical region of India. *African Journal of Agricultural Research*, 8 (26), 3462- 3472.

[12] Greven, M.M., Bennett, J.S., Neal, S.M. (2014). Influence of retained node number on sauvignon blanc grapevine vegetative growth and yield. *Australian journal of grape and wine research*, 20, 263–271.

[13] Minnaar, D.P.; Rijst, M.V.D., Hunter, K. (2022). Grapevine row orientation, vintage and grape ripeness effect on anthocyanins, flavan-3-ols, flavonols and phenolic acids: I. *Vitis vinifera* L. cv. Syrah grapes. *OENO One* 2022, 56, 275–293.

[14] Palliotti, A., Frioni, T., Tombesi, S., Sabbatini P., Cruz-Castillo, J.G., Lanari, V., Silvestroni, O., Gatti, M., Poni, S. (2017). Double-Pruning Grapevines as a Management Tool to Delay Berry Ripening and Control Yield. *American Journal of Enology and Viticulture.* doi: 10.5344/ajev.2017.17011.

[15] Permanhani, M., Miguel Costa, J.M., Conceição, M.A.F., de Souza, R.T., Vasconcellos, M.A.S., Chaves, M.M. (2016). Deficit irrigation in table grape: eco-physiological basis and potential use to save water and improve quality. Theor. *Exp. Plant Physiol*, 28 (1), 85–108.

[16] Sofoklis, P., Aikaterini, K., Ioannis, P., Yiorgos, K., Stamatina, K. (2017). Characterization of grape and wine proanthocyanidins of Agiorgitiko (*Vitis vinifera* L.cv.) cultivar grown in different regions of Nemea. *Journal of Food Composition and Analysis* http://dx.doi.org/10.1016/j.jfca.2017.07.038.

[17] Poni, S., Tombesi, S., Palliotti, A., Ughini, V., Gatti, M. (2016). Mechanical winter pruning of grapevine: Physiological bases and applications. *Scientia Horticulturae*, 204, 88–98. http://dx.doi.org/10.1016/j.scienta.2016.03.046.

[18] Ristiati, N.P., Suryanti, I.A.P., Widiyanti, N.L.P.M., Sudiatmika, A.A.I.A., Utama, A.P. (2019). Characterization of endophyt fungi in bali grapevine (*vitis vinifera* l. var alphonso lavalle) in Buleleng, Bali. *J. Phys*. Conf. Ser, 1317 012083. doi:10.1088/1742-6596/1317/1/012083.

[19] Sadras, V., Moran, M., Petrie, P. (2017). Resilience of grapevine yield in response to warming. *OENO One*, 51 (4), 381-386.

[20] Shah, S.S.A., Zeb, A., Qureshi, W.S., Arslan, M., Malik, A.U., Alasmary, W., Alanazi, E. (2020). Towards fruit maturity estimation using NIR spectroscopy. Infrared Phys. Technol, 111, 103479.

[21] Sukadi, S., Andriani, A., Harwanto, Yunimar, Tresnawati, T., Fami, A., Muhammad, F., Aprilianti, D., Yustisyia, M.L. (2021). Budidaya Tanaman Anggur. Bogor. Balai Besar Pengkajian dan Pengembangan Teknologi Pertanian.

[22] Tonietto, J., Carbonneau, A. (2004). A multicriteria climatic classification system for grape-growing regions worldwide. Agricultural and Forestry Meteorology, Amsterdam, 124, 81-97.

[23] Winarno, M. (1995). Cultivation of Grapevine in Indonesia. *JIRCAS International Symposium Series*, 3, 49-51.

[24] Wine Australia. (2023). Muscat de St Vallier. https://grapevinevariety.com/details/show/4757

[25] World Food and Agriculture. (2021). Statistical Yearbook 2021. Rome. FAO.

[26] Zhao, Z., Chu, C., Zhou, D., Sha, Z., Wu, S. (2019) Soil nutrient status and the relation with planting area, planting age and grape varieties in urban vineyards in Shanghai. Heliyon. 5, E02362

[27] Blancquaert, E.H., Oberholster, A., Ricardo-da-Silva, J.M., Deloire, A.J. (2019). Grape Flavonoid Evolution and Composition Under Altered Light and Temperature Conditions in Cabernet Sauvignon (Vitis vinifera L.). Front. Plant Sci. 10, 1062.