International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(4): 556-560
www.biochemjournal.com
Received: 21-01-2024
Accepted: 30-03-2024

Thutte AS
Ph.D. Research Scholar, Mahatma Phule Krushi Vidyapeeth, Rahuri, Maharashtra, India

Somkuwar RG
Principal Scientist, ICAR-National Research Centre for Grapes, Pune, Maharashtra, India

Dhemre JK
Associate Professor, Mahatma Phule Krushi Vidyapeeth, Rahuri, Maharashtra, India

Gharate PS
Ph.D. Research Scholar, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Ausari PK
Ph.D. Research Scholar, Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya, Gwalior, Madhya Pradesh, India

Kakade PK
Ph.D. Research Scholar, Mahatma Phule Krushi Vidyapeeth, Rahuri, Maharashtra, India

Corresponding Author:
Thutte AS
Ph.D. Research Scholar, Mahatma Phule Krushi Vidyapeeth, Rahuri, Maharashtra, India

Rootstock impact on quality attributes and shelf life of crimson seedless grapes

Thutte AS, Somkuwar RG, Dhemre JK, Gharate PS, Ausari PK and Kakade PK

DOI: https://doi.org/10.33545/26174693.2024.v8.i4g.1014

Abstract
The investigation was carried out during the fruit pruning season 2022-23 on 6-year-old vine of Crimson Seedless at ICAR- National Research Centre for Grapes, Pune. The vines were grafted on four different rootstocks (Dogridge, 110R, 140Ru and 1103P). The vines grafted on Dogridge rootstock recorded high TSS, lowest acidity and high TSS: Acidity ratio. 110R rootstocks had lowest berry firmness and skin thickness. 110R rootstock showed better results in organoleptic quality such as color, sweetness, taste, mouthfeel, flavor and overall acceptability as compared to other rootstocks. Rootstocks 110R recorded lowest rate of rachis dehydration and minimum physiological weight loss from bunches on different days of the shelf life. The vine grafted on Dogridge and 140Ru grafted vines recorded least rotten berries while 140Ru had the lowest number of fallen berries during shelf life. In conclusion, Crimson Seedless vines on 110R rootstock enhance shelf life and sensory quality of grapes, but terms of fresh grape quality Dogridge show better results.

Keywords: Rootstocks, crimson seedless, organoleptic, shelf life, PLW

Introduction

Grape is one of the major important fruit crops cultivated on an area of about 1.62 lakh hectares in India, yielding approximately 34.45 Lakh MT of produce (NHB, 2022). The primary grape growing regions in the country are in Maharashtra, Karnataka, Tamil Nadu, and Mizoram. Crimson Seedless is a coloured seedless grape variety gaining popularity in India, particularly for export purposes. Rootstocks are an integral part of grape cultivation, as they can affect yield (Jogaiah *et al.*, 2013) [6] and protect crops from pests such as phylloxera and nematodes (Kose *et al*., 2014) [9]. In India, most of grapes are harvested between January to April in the major grape growing regions. After harvest, grape berries are susceptible to deterioration due to high temperatures and low humidity. Since the berries have a thin skin and lose water rapidly, it can lead to rachis browning, berry shattering, and skin shrinkage, ultimately resulting in lower net return from the market. Extending the post-harvest life of grapes is crucial for obtaining higher returns and enabling transportation to distant domestic markets. This is a critical aspect of the grape supply chain that directly impacts market returns and satisfies consumer demand.

Various techniques for applying edible coatings can be used to prolong the shelf life and maintain the freshness of fruits, including the use of polyethylene wax emulsion, beeswax, chitosan and paraffin. Chitosan based coatings have become popular in recent years due to their non-toxic, biodegradable, and biocompatible properties (Jianglian and Shaoying, 2013) [5]. Rootstocks have the potential to impact vine growth and can either hasten or slow down the ripening process (Keller, 2010) [8]. By influencing the microclimate of the canopy and the technological ripening of the berries, rootstocks can also affect the production of phenolic compounds in grapes (Zombardo *et al*., 2020) [26]. Phenolic compounds are influenced by various factors, which are crucial in determining the sensory and organoleptic characteristics of wine. High vigor rootstocks such as 1103P and 140Ru can enhance the quality, composition, and sensory attributes of wine when regulated deficit irrigation is employed (Romero *et al*., 2019) [18]. The rootstock's impact on these aspects can affect the composition of phenolic compounds, sugars, and acids in the grapes, ultimately affecting the taste, aroma and mouthfeel of the wine.

Properly conducted sensory analysis can improve the knowledge of the effects of rootstock on grape quality.
Although, many researchers have explored the impact of rootstocks on scions growth, there is limited research on how they affect fruit behaviour during shelf. The aim of this study was to assess the effect of different rootstocks on Crimson Seedless grapes with a focus on both the shelf life and sensory analysis.

Materials and Methods

Present study was conducted at ICAR-National Research Centre for Grapes, Pune, during the fruit pruning season of 2022-23. The experimental site is situated in Mid-West Maharashtra at an altitude of 559 m above mean sea level (18.32°N and 73.51°E). Crimson Seedless variety was grafted on different rootstocks i.e. Dogridge, 110R, 140Ru and 1103P planted at spacing of 9 x 5 feet. Recommended standard cultural practices were followed to achieve desired crop under Pune conditions. The vineyard was trained to extended Y- Trellis system of training. Ten vine/treatments were randomly selected to measure the quality parameters of grapes. Freshly harvested bunches were brought to the lab to measure TSS, acidity, berry firmness and skin thickness. TSS was measured with a Hand Refractometer and acidity with titration method. Berry firmness percentage was measured using a firmness tester (Agrosta 100 Touchscreen) and berry skin thickness was measured using a micro meter (Mitutoyo).
The shelf-life was assessed on four rootstocks with five replications. Five bunches were collected from each replication per treatments. Fresh harvested grapes were then packed in plastic punnets and kept at room temperature and the observations were recorded upto7 days under shelf. Physiological loss in weight (PLW) was recorded by subtracting final weight from the initial weight of the bunch and then expressed as percent weight loss with reference to the initial weight.

Physiological loss in weight (PLW %) = Initial weight-Final weight/ initial weight x 100.

During the storage of grape bunches, the fallen and rotten berries were collected every day in punnets and counted and the numbers were presented. The observations were recorded on physiological loss in weight (PLW) upto 7days and fallen and rotten berries were recorded upto 5 days under shelf. The data was statistically analysed as per Panse and Sukhatme (1967) [14] to separate the means at 5% level of significance. Level of dehydration (LOD) or rachis browning was inspected and given a score from 0 to 4 (0 = healthy rachis, 1 = rachis turning brown, 2 = moderately brown rachis, 3 = sever brown rachis and 4 = extreme brown rachis) based on area and browning intensity. The LOD was calculated using t methods of Crisosto *et al.*, (2001) [2].
A group of 12 experts used a seven-point hedonic scale to conduct sensory analysis for evaluating standard organoleptic qualities (Adsule and Banerjee, 2003) [1]. Grape quality characteristics such as colour, sweetness, acidity, taste, mouthfeel, flavour, overall acceptability are included on the score card (Mane *et al.*, 1998) [12]. A completely randomized approach was used to analyse the sensory score data.

Result and Discussion

Quality parameters

The rootstock showed significant variation for grape berry qualities. The vines grafted on Dogridge rootstock recorded highest TSS (20.49), which was at par with 110R grafted vines (19.83), while the lowest TSS was recorded in 140Ru (19.04) grafted vines. In terms of acidity, Dogridge grafted vines had lowest values (90.55) which was at par to that of 110R (0.55) and 1103P (0.56), whereas the highest acidity was recorded in 140Ru (0.57). Somkuwar *et al.*, (2020) [20, 21] reported high TSS in Manjari Naveen grapevines grafted on Dogridge rootstocks. Similar findings were also reported in previous studies by Purohit *et al.*, (1979), Deol and Bindra (1975). Dogridge exhibited the highest TSS/Acidity ratio, which was significantly better than other rootstocks. The berry skin thickness was lowest in 110 (0.27) and 140Ru (0.27) grafted vines. Berry firmness was non-significant results on different rootstocks. The berry firmness is generally related to the pulp development during the berry development stage. This is also a result of proper doses of phosphorous, magnesium and calcium applied for berry development after forward pruning. The firmness of berries was found to be strongly associated with the amount of weight and water lost by the berries (Kader, 2002) [7].

Table 1: Effect of rootstocks on quality parameters of Crimson Seedless grapes

Rootstocks	TSS	Acidity	TSS: Acidity ratio	Berry skin thickness	Berry firmness
Dogridge	20.49	0.54	38.17	0.29	85.80
110R	19.83	0.55	36.02	0.27	83.26
140Ru	19.04	0.57	33.32	0.27	86.25
1103P	19.34	0.56	34.62	0.29	84.84
SE(m±)	0.25	0.006	0.47	0.004	1.04
CD 5%	0.76	0.020	1.46	0.012	NS

Physiological loss in weight (PLW %)

Significant differences were observed in Crimson Seedless grafted on different rootstocks (table 2). The losses were at a minimum at the initial days but it increased during the period of shelf. During the first two days under the shelf, the moisture loss from the grape berries was more during the subsequent period of storage and its ultimately increased PLW%. Among the rootstocks, 110R grafted vines had minimum PLW during the period under shelf. While, maximum PLW was recorded in 140Ru, Dogridge and 1103P grafted vines which were at par with each other. It is evident that the rootstock 110R is more effective in reducing water loss compared to other rootstocks. The minimum PLW always leads to freshness of grape berries, which ultimately increase the shelf life. The reduction of water loss from grape tissues under high humidity in cold storage apparently inhibits the collapse of epidermal layer and underlying cells and thus commodity remains fresh for longer period (Sharma *et al.*, 1991) [19]. Dogridge rootstock was found better for minimizing PLW in Thompson

Seedless compared to other rootstocks (Somkuwar *et al.*, 2006) [23]. Loay (2011) [10] reported that Paulson rootstock reduces the water loss during shelf life by increasing accumulation waxes on berry surface during berry development and it also acts as a protective layer against dehydration. The maintenance of high humidity in cold storage helps to prevent water loss from grape tissues, which in turn inhibits the collapse of the epidermal layer and underlying cells. This leads to the fruit remaining fresh for a longer period of time (Sharma *et al.*, 1991) [19]. Somkuwar *et al.*, (2006) [23] reported Dogridge rootstock is more efficient than other rootstocks in minimizing PLW in Thompson Seedless grapes.

Table 2: Effect of rootstocks on Physiological loss in weight (PLW %)

Physiological loss in weight (PLW %)							
Rootstocks	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**
Dogridge	1.38	1.75	2.69	3.22	3.86	4.54	5.09
110R	1.33	1.46	2.51	2.99	3.51	4.27	4.68
140Ru	1.21	1.69	2.47	3.20	3.80	4.41	5.10
1103P	1.11	1.67	2.55	3.11	3.87	4.49	4.99
SE (m±)	0.02	0.02	0.03	0.04	0.05	0.06	0.07
CD 5%	0.05	0.07	0.10	0.13	0.02	0.18	0.20

Level of dehydration (LOD)

During the shelf, it was observed that the level of dehydration (LOD) was the lowest in 110R rootstock for up to 5 days (Table 3). However, the rachis browning level increased gradually with each passing day. The highest level of rachis browning was observed in 140Ru on first (0.8) and fourth (2.8) days, Dogridge on second (1.6) and fifth (3.6) days and 1103 on the third day (2.4) of shelf life. Browning incidence may be due to the oxidation of phenolic compounds through polyphenol oxidase (PPO) activity (Yokotsuka *et al.*, 1988) [25]. Loay, (2005) [10] reported that Flame Seedless grafted on Paulsen rootstock have a high ascorbic acid content in fruit clusters. This can protect the rachis by scavenging active oxygen species during shelf-life stress. Thicker pedicels resulting from minimized browning delayed grape bunch senescence, increased firmness, and increase shelf life (Somkuwar *et al.*, 2006) [23].

Table 3: Effect of rootstocks on level of dehydration (LOD)

Level of dehydration (LOD)					
Rootstocks	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**
Dogridge	0.6	1.6	2.0	2.6	3.6
110R	0.6	1.0	1.4	2.2	3.0
140Ru	0.8	1.4	1.8	2.8	3.6
1103P	0.4	1.4	2.4	2.7	3.4
SE (m±)	0.009	0.010	0.029	0.029	0.030
CD 5%	0.028	0.032	0.091	0.089	0.094

Level of dehydration (LOD) or rachis browning score (0 = healthy rachis, 1 = rachis turning brown, 2 = moderately brown rachis, 3 = sever brown rachis and 4 = extreme brown rachis)

Rotten (RB) and fallen berry (FB)

The data on fallen berry and rotten berry as influenced by the use of different rootstocks on Crimson Seedless grapes is presented in Table 4. There was no berry detachment (berry fall) observed in first two days in 140Ru rootstock. In third and fourth day, rotten berry was reduced in the Dogridge rootstock (1.40 and 0.80, respectively) grafted vines but in fifth day 110R (1.40) showed minimum berry rot. The grapes obtained from 140Ru grafted vines recorded the lowest fallen berry in first, second, third, fourth and fifth days of shelf (0.40, 0.80, 1.00, 1.40 and 2.00, respectively), but in first and fifth day it showed similar results with 1103P (0.40) and 110R (2.00), respectively. Reducing the rate of rachis browning resulted into decreased berry drop. Somkuwar *et al.*, (2006) [23] found that Thomson Seedless grafted on St. George rootstock experienced high-rate pedicel browning, resulting in shrivelled berries and a shorter shelf life. Rao and Nalwadi (1968) [16] noted that decrease in berry drop as a result of increased pedicel thickness in Anab-e-Shahi and Pandhari Sahebi grapes. Susceptibility of the berry to shatter is due to a climacteric process in which the pedicel and brush of the berry show peaks in respiration and ethylene (Yiqiang *et al.*, 1997) [24]. These peaks lead to increased water loss (Rogiers *et al.*, 2004) [17] and the formation of an abscission layer at the distal end of the pedicel of the berry (Crisosto *et al.* 2001) [2].

Table 4: Effect of rootstocks on rotten berry (RB)and fallen berry (FB)

Rotten Berry (RB)						Fallen Berry (FB)					
Rootstocks	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Rootstocks**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**
Dogridge	0.60	0.60	1.40	0.80	2.00	Dogridge	1.20	1.80	1.80	2.40	2.80
110R	0.60	0.80	2.00	0.81	1.40	110R	0.60	1.40	1.40	1.60	2.00
140Ru	0.00	0.00	1.80	1.40	2.60	140Ru	0.40	0.80	1.00	1.40	2.00
1103P	0.00	0.20	2.40	2.20	3.80	1103P	0.40	1.00	1.60	2.00	2.04
SE (m±)	0.018	0.016	0.026	0.042	0.07	SE (m±)	0.030	0.030	0.030	0.040	0.050
CD 5%	0.056	0.052	0.08	0.131	0.216	CD 5%	0.080	0.100	0.100	0.130	0.150

Organoleptic test

Different organoleptic attributes significantly varied among the rootstocks (Figure 1). Crimson Seedless grapes grafted on 110R rootstock scored high for colour (7.36), sweetness (7.64), flavour (7.50), taste (7.79), mouthfeel (7.50) and overall acceptability (7.71). It was followed by 1103P in Colour (7.21), 140Ru in Sweetness (7.57), Flavour (7.14), Taste (7.50), mouthfeel (7.43) and overall acceptability (7.46). Dogridge had the lowest scores in colour, sweetness, flavour, taste, mouthfeel and acidity, while 140Ru had the highest score in acidity. Somkuwar *et al.*, (2020) [21] studied variability in organoleptic test of raisins produced from different varieties. Rootstocks can influence the sensory profile of grapes by affecting factors like vine vigour and nutrient uptake, leading to variations in grape characteristics such as flavour and aroma. The sensory analysis of wine prepared form 5C rootstock grafted vines presented more color intensity, more astringency and more meaty aromas compared with wine made from Gravesac grafted vines in Syrah grapes (Heller *et al.*, 2023) [4].

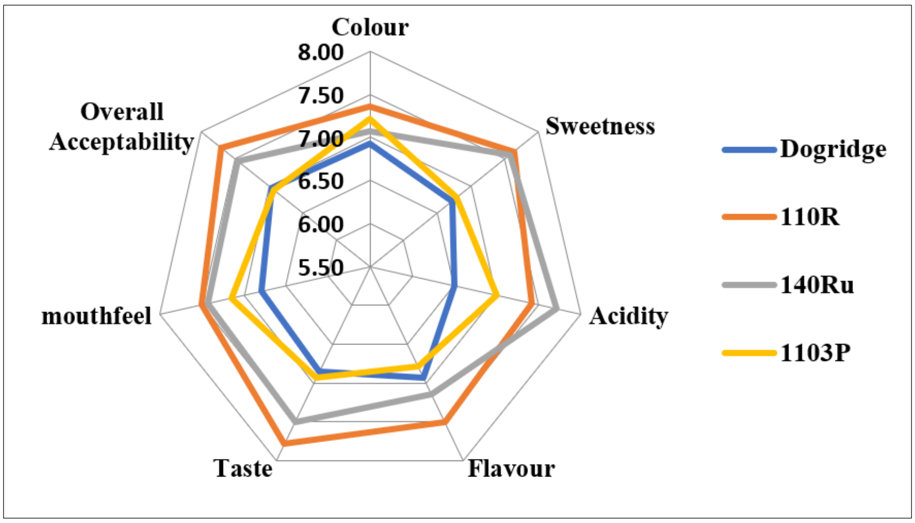

Fig 1: Organoleptic quality of Crimson Seedless grapes on rootstocks

Conclusion

Rootstocks have indirect influence on the quality of harvested grapes by enhancing the uptake of certain nutrients that play important role in the post-harvest life of grapes. Among different rootstocks, Dogridge was found to be good in terms of TSS and acidity levels, while 110R was better for berry firmness and skin thickness. The 110R rootstock was found to have good organoleptic quality, minimum PLW%, and the lowest rate of rachis dehydration (LOD). Therefore, Crimson Seedless grafted on 110R rootstock is considered ideal for maintaining good sensory quality and increasing the shelf life of grapes.

References

1. Adsule PG, Banerjee K. Standardization of quality of Indian raisins with reference to codex standards and harmonization of Indian Standards. Indian food Packers; c2003. p. 59-63.
2. Crisosto C, Smilanick J, Dokoozlian N. Table grapes suffer water loss, stem browning during cooling delays. California Agriculture. 2001;55:39-42.
3. Deol IS, Bindra AS. Improvement of yield and quality of grapes (*Vitis vinifera* L.) through the use of different rootstocks. Punjab Hort. J. 1975. p. 15.
4. Heller Fuenzalida F, Cuneo IF, Kuhn N, Pena Neira A, Caceres Mella A. Rootstock Effect Influences the Phenolic and Sensory Characteristics of Syrah Grapes and Wines in a Mediterranean Climate. Agronomy. 2023;13(10):25-30.
5. Jianglian D, Shaoying Z. Application of chitosan based coating in fruit and vegetable preservation: A review. J Food Process. Technol. 2013;4(5):227.
6. Jogaiah S, Oulkar DP, Banerjee K, Sharma J, Patil AG, Maske SR, *et al*. Biochemically induced variations during some phenological stages in Thompson Seedless grapevines grafted on different rootstocks. South African J. Enol. Vitic. 2013;34(1):36-45.
7. Kader AA. Postharvest technology of horticultural crops. University of California Agriculture and Natural Resources; c2002. p. 3311.
8. Keller M. Managing grapevines to Optimise fruit development in a challenging environment: A climate change primer for viticulturists. Aust. J. Grape Wine Res. 2010;16:56-69.
9. Kose B, Karabulut B, Ceylan K. Effect of rootstock on grafted grapevine quality. Eur. J Hortic. Sci. 2014;79:197-202.
10. Loay AA. Chilling Injury in Mangoes. Ph.D. Thesis. University, Wageningen; c2005. p. 1-224.
11. Loay AA. Biological indicators to minimize berry shatter during handling of Thompson seedless grapevines. World Appl. Sci. J. 2011;12:1107-1113.
12. Mane BB, Adsule RN, Kachare DP. Chemical composition and sensory properties of raisins prepared by different methods. J. Maharashtra Agric. Univ. 1998;23(1):71-72.
13. National Horticultural Board (NHB). Indian horticultural database, Ministry of Agriculture. Retrieved from www.nhb.gov.in. 2022.
14. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. ICAR Pub. New Delhi; c1967. p. 152-65.
15. Purohit AG, Shikhamany SD, Kumar P. Effect of Number of Leaves Per Bunch on Growth and Quality of Anab-E-Shahi Grape (*Vitis vinifera* L.). Indian J Hortic. 1979;36(1):36-41.
16. Rao MM, Nalvadi UG. Effect of naphthaleneacetic acid on pedicel thickness of grapes. Current Science; c1968. p. 503-505.
17. Rogiers SY, Hatfield JM, Jaudzems VG, White RG, Keller M. Grape berry cv. Shiraz epicuticular wax and transpiration during ripening and preharvest weight loss. Am J Enol Vitic. 2004;55(2):121-127.
18. Romero P, Botia P, Del Amor FM, Gil Munoz R, Flores P, Navarro JM. Interactive effects of the rootstock and the deficit irrigation technique on wine composition, nutraceutical potential, aromatic profile and sensory attributes under semiarid and water limiting conditions. Agric. Water Manag. 2019;225:105733.
19. Sharma RD. Jitendra Kumar and Ram Singh. Shelf life of grapes as affected by various packing material and chemicals. Haryana J Hort. Sci. 1991;20(1-2):39-43.
20. Somkuwar RG, Kad S, Naik S, Sharma AK, Bhange MA, Bhongale AK. Study on quality parameters of grapes (*Vitis vinifera*) and raisins affected by grape type. Indian J Agric. Sci. 2020;90(6):1072-1075.
21. Somkuwar RG, Samarth R, Ghule VS, Sharma AK. Crop load regulation to improve yield and quality of

Manjari Naveen grape. Indian J Hortic. 2020;77(2):381-383.
22. Somkuwar RG, Satisha J, Bondge DD, Itroutwar P. Effect of bunch load on yield, quality and biochemical changes in Sharad Seedless grapes grafted on Dog Ridge rootstock; c2000.
23. Somkuwar RG, Satisha J, Ramteke SD, Sharma J. Effect of rootstocks and pre-harvest treatments on storage life of Thompson Seedless grapes. In International Symposium on Grape Production and Processing. 2006;785:441-446.
24. Yiqiang G, Weiyi Z, Ying C, Qiang Y. Effect of sulfur dioxide on the respiration and the hormone levels of postharvest table grapes. Acta Hortic. Sin. 1997;24(2):120-124.
25. Yokotsuka K, Makino S, Singleton VL. Polyphenol oxidase from grapes: precipitation, re-solubilization and characterization. Am. J Enol. Vitic. 1988;39(4):293-302.
26. Zombardo A, Crosatti C, Bagnaresi P, Bassolino L, Reshef N, Puccioni S, *et al*. Transcriptomic and biochemical investigations support the role of rootstock-scion interaction in grapevine berry quality. BMC genomics. 2020;21(1):1-20.