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Influence of cane biochemical content on yield and quality of Red Globe grapevines grafted on different rootstocks

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Abstract
The investigation was carried out to study the influence of cane biochemical content on yield and quality of Red Globe grapevines grafted on different rootstocks during the year 2018-19 and 2019-20. The cane biochemical parameters such as total phenol, carbohydrate, protein and proline content were analysed before fruit pruning whereas, yield and quality parameters such as number of bunches per vine, berry weight and berry diameter were recorded at harvest. The highest cane total phenol, carbohydrate and protein content were recorded in vines grafted on Dogridge rootstock. Whereas, highest proline content was recorded in vines grafted on 110R rootstock. The maximum berry weight and berry diameter were noted in vines grafted on Dogridge rootstock while highest number of bunches were found on Red Globe grapevines grafted on 110R rootstock for both the years of study. The present study revealed that rootstocks had significant effect on cane biochemical contents, yield and quality parameters, Red Globe vines grafted on rootstock proved better for biochemical, yield and quality parameters while Red Globe own rooted vines recorded lowest performance. Higher cane biochemical content before fruit pruning clearly indicates the nutrient and storage status of vine. The higher cane storage results into the improved and quality grape production.

Keywords: Grape, cane biochemical, rootstock, red globe, carbohydrate, berry weight

Introduction
The cultivation of grape is increasing in the sub-tropical and tropical conditions of India due to the favourable climatic conditions and quality grape production. It is an important remunerative fruit crop in the world (Somkuwar *et al.*, 2020) [19]. The area under grape cultivation is around 1.40 lakh ha which contribute an annual production of 31.25 lakh MT with an average productivity of 21.00 MT/ha (Anonymous, 2020) [1]. Traditional grape cultivation in India entailed growing commercial varieties of grapes on its own roots. However, with the circumstances of deteriorating soil and irrigation water conditions, the use of rootstock in grape cultivation has become mandatory in the subcontinent. An increasing occurrence of soil salinity, drought and declining productivity of grape in India has made the use of suitable rootstocks imperative (Singh and Sharma, 2005) [13]. The canes are the mature shoot part of dark brown colour which has great significance in the grape production. The different manipulation in canes like number, thickness and length had a better impact on quality grape production as the internal biochemical content controls the fruitfulness, disease resistance, storage which positively results into the higher yield and quality grape production. Red Globe is attracting the consumers due to its affectionate red colour, round, crispy, mild sweet, medium large berries and the variety is gaining demand in Indian markets, growers are concentrating their efforts to obtain quality grape but several constraints are affecting its production under tropical conditions (Somkuwar *et al.*, 2021) [20]. Hence, the two year experiment were carried out to study the influence of cane phenol, carbohydrate, protein and proline content on Red Globe grapevines grafted on different rootstocks.
Satisha *et al.* (2007) [11] evaluated the physiological and biochemical parameters of grape rootstocks and observed the group of *Vitis berlandierii* x *Vitis rupestris*, such as 110R, 1103P, 99R and B2-56, had a significantly higher content of total phenols, flavon-3-ols, flaveonoids, proline and total protein in canes. Rizk-Alla *et al.* (2011) [10]; Somkuwar *et al.* (2013) [16] and Elaidy *et al.* (2019) [3] reported that Red Globe grapevines grafted rootstocks recorded highest cane biochemical content and storage than the own rooted vines.

Material and Methods

The investigation was carried out at ICAR-National Research Centre for Grapes, Pune (MS), during the year 2018-19 and 2019-20. The research was conducted on five year old vineyard of *cv.* Red Globe established on different rootstocks during 2018-19 and 2019-20. The vines were trained 'extended Y' system of training with four cordons (H shape – Height = 1.20 m from ground, cross arm width = 0.60 m) developed horizontally with vertical shoot orientation on each cordon. A distance of 0.60 m was maintained from the fruiting wire to the top of foliage support wire. The soil in the region is heavy black with pH 7.75 and EC 0.46 dS m^{-1}. The region falls under a tropical belt, where double pruning and single cropping is being practiced, the foundation pruning was carried out in the month of April and fruit pruning during the month of October. Red Globe grapevines grafted on different rootstocks taken as a treatments (Dogridge, 110R, 140Ru, Salt Creek and own roots of Red Globe grapevines). The cane samples were collected just before fruit pruning. Randomly three matured canes were taken from each vine and five vines were selected per replication. The harvested canes were oven dried and crushed in machine. A fine powder was prepared and was stored at 4 ^{0}C to use for further analysis. The yield and quality parameter were recorded after fruit pruning.

Cane biochemical estimation

Total phenolic content in canes was estimated using Folin-Ciocalteu reagent and by measuring the absorbance of the reaction mixture at 630 nm (Singleton and Rossi, 1965) [14]. The total phenol content (mg/g DW) was calculated from the standard curve using Gallic acid as standard and expressed as mg of Gallic acid (GA) equivalent per gram of dry weight sample. Estimation of carbohydrate was done by the Anthrone method (Hedge and Hofreiter, 1962) [6]. The carbohydrate content (mg/g DW) was measured by plotting graph using glucose as standard and the carbohydrate content of the sample was calculated as mg per gram dry weight of sample. Protein estimation was carried out by colorimetric method described by Lowry *et al.* (1951) [7]. The protein content (mg/g DW) was calculated from the standard curve using bovine serum albumin as standard and expressed as mg of bovine serum albumin (BSA) equivalent per gram of dry weight sample. Proline content (µmoles/g DW) was estimated colorimetrically according to the method suggested by Bates *et al*., (1973) [2]. The proline content was calculated from the standard curve using proline as standard and expressed as µmoles of proline equivalent per gram of dry weight sample.

Yield and quality parameter

The number of bunches per vine were counted from five vines in each replication and their mean was recorded. A berry weight was estimated using weighing balance and expressed in grams. The berry diameter was recorded from 10 berries collected from five bunches from each vine separately and their diameter was recorded with the help of Vernier-calliper and average was calculated and expressed in mm.

Statistical analysis

The experiment was conducted in Randomized Block Design (RBD) consisting of five treatments as rootstocks which were replicated four times. Statistical analysis of data collected during the course of studies was carried out by standard method of analysis of variance as described by Panse and Sukhatme (1985) [9]. The standard error of mean (S.Em±) was worked out and the critical difference at 5 per cent level of significance was calculated wherever the results were found significant.

Results and Discussion

Cane biochemical content

The mean data of the year 2018-19 and 2019-20 pertaining to the effect of different rootstocks on cane biochemical content in Red Globe grapevines before fruit pruning are presented in Table 1. The rootstocks showed non-significant effect for cane total phenol content before fruit pruning for the year 2018-19 while second year (2019-20) study showed significant effect. In 2019-20 higher cane total phenol content was recorded in Red Globe grapevines grafted on Dogridge rootstock (3.88 mg/g DW) which was at par with vines grafted on Salt Creek rootstock (3.85 mg/g DW) it was followed by 110R rootstock (3.51 mg/g DW) and own rooted vines (3.59 mg/g DW) while lower cane total phenol content was recorded in vines grafted on 140Ru rootstock (3.42 mg/g DW). The vines grafted on Dogridge rootstock recorded high cane total phenol content. Phenol content in canes has important for maintaining structural integrity of vine. Phenol content found in grafted vines was higher than in own-rooted vines. This might be due the genetic differences among the rootstocks for mineral absorption (Fazio *et al*., 2015) [4]. Phenolic compounds occur naturally in plant systems and are known for their anti-microbial properties. These inhibit fungal-spore germination, mycelial-fungal enzymes and toxin production by pathogens (Vidhyasekran, 1973) [23]. Higher level of phenolic compounds in a plant system imply greater tolerance to biotic stresses (Goetz *et al.*, 1999) [5]. This findings are in close conformity with the results of Satisha *et al*. (2007) [11] who reported that 99R and Dogridge rootstock canes have more total phenol content. Somkuwar *et al*. (2013) [16] reported that canes of Tas-A-Ganesh vines grafted on Dogridge rootstock have more phenol content than own rooted vines.

The Red Globe grapevines grafted on different rootstocks showed the significant effect for cane carbohydrate content in both the years of study. In 2018-19 and 2019-20 the highest cane carbohydrate content was recorded in vines grafted on Dogridge rootstock (441.56 and 445.65 mg/g DW) which was significantly superior over all other rootstocks and own rooted vines. It was followed by Red Globe grapevines grafted on Salt Creek (404.44 and 409.51 mg/g DW) and 110R (402.02 and 406.89 mg/g DW) rootstocks respectively. The lowest cane carbohydrate was recorded in own rooted vines (358.61 and 360.62 mg/g DW) respectively which was followed by vines grafted on 140Ru rootstock (397.10 and 402.13 mg/g DW), respectively. The cane carbohydrate content showed significant differences among the rootstocks and Red Globe own rooted vines. The canes of Red Globe grapevines grafted on Dogridge rootstock recorded higher carbohydrate content. Increase in carbohydrate content in grafted vines might be due to the fact that grafted vines are more efficient in nutrient uptake and storage of carbohydrates (Somkuwar *et al*., 2013) [16]. Rizk-Alla *et al*. (2011) [10] also reported that canes of Red Globe grapevines grafted on Dogridge followed by Salt Creek rootstock recorded higher carbohydrate content. Somkuwar *et al*. (2013) [16] reported that canes of Tas-A-Ganesh vines grafted on Dogridge rootstock have more carbohydrate content than own rooted vines.

The cane protein content in first year (2018-19) of study was

recorded in Red Globe grapevines grafted on Dogridge rootstock (1.86 mg/g DW) which was at par with vines grafted on Salt Creek (1.65 mg/g DW) and 110R (1.59 mg/g DW) rootstocks. The minimum protein in cane was recorded in own rooted vines (1.19 mg/g DW) which was at par with vines grafted on 140Ru rootstock (1.42 mg/g DW). In 2019-20 the maximum cane protein content was recorded in Red Globe grapevines grafted on Dogridge rootstock (1.87 mg/g DW) which was significantly superior among the rootstock. It was followed by vines grafted on Salt Creek (1.63 mg/g DW) and 110R (1.59 mg/g DW) rootstocks while minimum cane protein content was recorded in Red Globe own rooted vines (1.21 mg/g DW) followed by vines grafted on 140Ru rootstock (1.40 mg/g DW) respectively. The protein content in cane was significantly influenced by different rootstocks. Red Globe grapevines grafted on Dogridge rootstock recorded highest cane protein content. This might be due to the alterations in the growth pattern of the vines by rootstocks as well as the differences in their uptake of nutrients and water from soil solution, as root development patterns vary with the rootstocks (Somkuwar *et al*., 2014b) [18]. Similar results were reported by Satisha *et al*. (2007) [11] who reported that cane protein content was significantly influenced among different rootstocks. Somkuwar *et al*. (2014a) [17] in Thompson Seedless and Somkuwar *et al*. (2013) [16] in Tas-A-Ganesh who reported that vines grafted on Dogridge rootstock had higher cane protein content than own rooted vines.

The cane proline content was also significantly influenced by the different rootstocks. In first year (2018-19) of study higher cane proline content was recorded in Red Globe grapevines grafted on 110R rootstock (3.36 µmoles/g DW) which was at par with vines grafted on Salt Creek rootstock (3.14 µmoles/g DW) while lower cane proline content was recorded in vines grafted on Dogridge rootstock (2.45 µmoles/g DW) which was at par with 140Ru rootstock (2.65 µmoles/g DW) and own rooted vines (2.48 µmoles/g DW). In second year (2019-20) of study, higher cane proline content was recorded in Red Globe grapevines grafted on 110R rootstock (3.52 µmoles/g DW) which was significantly superior among the rootstocks. It was followed by vines grafted on Salt Creek rootstock (3.05 µmoles/g DW) while lower cane proline content was recorded on vines grafted on 140Ru (2.51 µmoles/g DW) which was at par with own rooted vines (2.58 µmoles/g DW) followed by Dogridge rootstock (2.95 µmoles/g DW). Proline is one of the important osmoprotectants during drought and salinity stress and the rootstocks can be categorised on the basis of proline synthesis and its accumulation in the leaves (Satisha *et al*., 2007) [11]. In the present study, vines grafted on 110R rootstock recorded higher cane proline content. This might be due to the 110R (*Vitis berlandieri* x *Vitis rupestris*) rootstock hybrid and both have a good tolerance to stress conditions (Ulhas *et al*., 2014) [22]. This findings are in close conformity with the results of Satisha *et al*. (2007) [11] who reported that vines on 110R rootstock have higher proline content. Ulhas *et al*. (2014) [22] reported that Syrah grafted on 110R rootstock had more proline content than other rootstocks.

Yield and quality parameter

The productivity of grape is mainly depends on fruitfulness of canes and which are directly related to cane internal biochemical content and storage of vine. The results obtained over two years (2018-19 and 2019-20) clearly indicated that number of bunches/vine significantly influenced by use of rootstocks for same scion cultivar. The highest number of bunches/vine in 2018-19 was recorded in Red Globe grapevines grafted on 110R rootstock (49.40) which was significantly superior among rootstocks followed by 140Ru rootstock (45.40). While lowest number of bunches/vine was recorded on own rooted vine (41.55) which was at par with Dogridge (43.55) and Salt Creek (44.25) rootstocks. In 2019-20, the highest number of bunches were observed in Red Globe grapevines grafted on 110R rootstock (47.38) which was at par with Salt Creek (46.90) and 140Ru rootstock (44.13). The lowest number of bunches/vine were recorded on own rooted vine (40.50) which were at par with Dogridge rootstock (41.75). The vines grafted on rootstock recorded significantly higher number of bunches than own rooted vines. In a present study higher number of bunches were recorded in vines grafted on 110R rootstock. It might be due to higher phosphorus uptake by the 110R rootstock which results into higher number of bunches per vine. The higher cane biochemical content in vines grafted on rootstocks than own rooted vines also responsible for the higher fruitfulness. Similar findings were reported by Tambe and Gawade (2004) [21] who reported the maximum number of bunches per vine in Thompson Seedless grafted on Dogridge rootstock. Satisha *et al*. (2010) [12] who recorded higher number of bunches in Thompson Seedless grapevines grafted on 110R rootstocks.

The berry weight is an important aspect in quality grape production which was significantly influenced by the use of different rootstocks. In both the years of study, the higher berry weight was noted in Red Globe grapevines grafted on Dogridge rootstock (5.83 and 5.82 g) which was followed by vines grafted on 110R rootstock (5.50 and 5.52 g) while lowest berry weight was found in vines grafted on 140Ru rootstock (4.69 and 4.77 g) respectively. This might be due the environmental conditions at the time of maturity and different genetic constitution of rootstocks as well as the higher carbohydrate and protein responsible for proper source-sink balance which results into utilization of more stored carbohydrates for available berries (Somkuwar *et al*., 2020) [19]. The higher proline content in canes provide better protection against biotic and abiotic stresses which results into better weight and quality of berry. Similar results were reported by Somkuwar *et al*. (2010) [15] in Tas-A- Ganesh grapes.

The berry diameter also significantly influenced by the use of different rootstock. During the first year (2018-19) of study, the higher berry diameter was recorded in Red Globe grapevines grafted on Dogridge rootstock (22.14 mm) which was at par with vines grafted on Salt Creek (22.12 mm) and 110R rootstock (21.49 mm) while lower berry diameter was recorded in 140Ru grafted vines (21.19 mm). It was statistically at par with own rooted vines (21.36 mm). In 2019-20 the higher berry diameter was recorded on Dogridge rootstock (22.04 mm) which was at par with vines grafted on Salt Creek rootstock (22.00 mm) while lower berry diameter was recorded in vines grafted on 140Ru rootstock (21.09 mm) which was at par with 110R rootstock (21.09 mm) and own rooted vines (21.20 mm), respectively. The berry diameter is an important parameter for quality grape production (Matthews and Nuzzo, 2006) [8]. The higher photosynthetic rate, cane carbohydrate and protein storage which leads to higher accumulation of food material towards developing berries and results into higher berry diameter.

Conclusion

The above investigation concluded that rootstocks had

significant effect on cane biochemical, yield and quality parameters of Red Globe grapevines. The vines grafted on rootstocks performed better for cane biochemical, yield and quality parameters as compared to own rooted vines. The higher storage in canes results into the better fruitfulness and higher yield. Hence, considering all above parameters Red Globe grapevines grafted on Dogridge rootstock followed by vines grafted on 110R rootstock proved better for accumulating more cane storage and other biochemical contents and it also gives higher berry weight and berry diameter which results into the higher yield.

Table 1: Effect of different rootstocks on cane biochemical content of Red Globe grapevines

Rootstock	Total phenol (mg/g DW)		Carbohydrate (mg/g DW)		Protein (mg/g DW)		Proline (µmoles/g DW)	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
Dogridge	3.84	3.88	441.56	445.65	1.86	1.87	2.45	2.95
110R	3.46	3.51	402.02	406.89	1.59	1.59	3.36	3.52
140Ru	3.44	3.42	397.10	402.13	1.42	1.40	2.65	2.51
Salt Creek	3.82	3.85	404.44	409.51	1.65	1.63	3.14	3.05
Own root	3.63	3.59	358.61	360.62	1.19	1.21	2.48	2.58
S.Em.±	0.24	0.02	7.69	2.81	0.09	0.04	0.16	0.02
CD at 5%	NS	0.05	23.68	8.69	0.29	0.11	0.48	0.07

Table 2: Effect of different rootstocks on yield and quality of Red Globe grapevines

Rootstock	Number of bunches/ vine		Berry weight (g)		Berry diameter (mm)	
	2018-19	2019-20	2018-19	2019-20	2018-19	2019-20
Dogridge	43.55	41.75	5.83	5.82	22.14	22.04
110R	49.40	47.38	5.50	5.52	21.49	21.09
140Ru	45.40	44.13	4.69	4.77	21.19	21.09
Salt Creek	44.25	46.90	5.28	4.99	22.12	22.00
Own root	41.55	40.50	4.98	5.06	21.36	21.20
S.Em.±	1.00	1.24	0.04	0.07	0.26	0.22
CD at 5%	3.09	3.83	0.12	0.20	0.74	0.64

References

1. Anonymous. Area and Production of Horticulture Crops: All India (National Horticultural Board) 2020.
2. Bates LS, Waldren RP, Teare ID. Rapid determination of free proline for water-stress studies. Plant Soil, 1973;39:205-207.
3. Elaidy AA, Abo-Ogiala AM, Khalf IR. Effect of different grape rootstocks on the growth, yield and quality of Superior grape under salt stress. Middle East J. of Agril. Res 2019;8 (1):167-175.
4. Fazio G, Chang L, Grusak MA, Robinson TL. Apple rootstocks influence mineral nutrient concentration of leaves and fruit. New York Fruit Quarterly, 2015;23(2):11-15.
5. Goetz G, Fkyerat A, Metais N, Kunz M, Tabacchi R, Pezet R *et al*. Resistance factors to grey mould in grape berries: identification of some phenolics inhibitors of *Botrytis cinerea* stilbene oxidase. Phytochem. 1999;52:759-767.
6. Hedge JE, Hofreiter BT. Methods. In: R. L. Whistler and J.N. Be Miller (eds.). Carbohydrate chemistry, p. 17, Academic Press, New York 1962.
7. Lowry OH, Rosenbrough NJ, Farr AL, Randall RJ. Protein measurement with the folin phenol reagent. J. Biol. Chem 1951;193(1):265-275.
8. Matthews MA, Nuzzo V. Berry size and yield paradigms on grapes and wines quality. Proc. Intl. WS on Grapevine Acta Hort. 2006;754:423-435.
9. Panse VG, Sukhatme PV. Statistical methods for Agricultural workers, I.C.A.R. New Delhi 1985.
10. Rizk-Alla MS, Sabry GH, Abd El-Wahab MA. Influence of Some Rootstocks on the Performance of Red Globe Grape Cultivar. J. of American Sci. 2011;7(4):71-81.
11. Satisha J, Ramteke SD, Karibasappa GS. Physiological and biochemical characterisation of grape rootstocks. *S.* Afr. J. Enol. Vitic., 2007;28(2):163-168.
12. Satisha J, Somkuwar RG, Sharma J, Upadhyay AK, Adsule PG. Influence of rootstocks on growth, yield and fruit composition of Thompson Seedless grapes grown in the Pune region of India. South Afr. J of Enol. and Vitic., 2010;31(1):1-8.
13. Singh M, Sharma JK. Effect of rootstocks on disease intensity of Perlette grape vine. Haryana J Hortic. Sci 2005;34:234-235.
14. Singleton VL, Rossi JA. Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. Am. J Enol. Vitic 1965;16:144-158.
15. Somkuwar RG, Satisha J, Ramteke SD. Effect of bunch load on berry growth in Tas-A-Ganesh grafted on different rootstock. Indian J. of Hort 2010;67(4):578-580.
16. Somkuwar RG, Satisha J, Ramteke SD. Berry weight, quality and cane biochemistry changes in relation to cane thickness of own-rooted and grafted 'Tas-A-Ganesh' grape. J. Hortl. Sci 2013;8(1):30-34.
17. Somkuwar RG, Jogaiah S, Sawant SD, Taware PB, Bondage DD, Itroutwar P. Rootstocks influence the growth, biochemical contents and disease incidence in Thompson Seedless grapevines. British Journal of Applied Science & Technology 2014a;4(6):1030-1041.
18. Somkuwar RG, Samarth RR, Itroutwar P, Navale S. Effect of cluster thinning on bunch yield, berry quality and biochemical changes in local clone of table grape cv. Jumbo Seedless (Nana Purple). Indian J. Hort 2014b;71(2):184-189.
19. Somkuwar RG, Samarth R, Ghule VS, Sharma AK. Crop load regulation to improve yield and quality of Manjari Naveen grape. Indian J. Hort 2020;77(2):381-383.
20. Somkuwar RG, Bhor VA, Ghule VS, Hakale D, Shabeer A, Sharma AK. Rootstock affects stress relieving enzymatic activity during bud break in 'Red Globe' grapevine under semi-arid condition. *Vitis*, 2021;60:93-99.

21. Tambe TB, Gawade MH. Influence of rootstocks on vine vigour, yield and quality of grapes. Acta Hortic 2004;662:37.
22. Ulas S, Guler A, Candemir A. Effect of rootstocks on different physiological parameters in some grape cultivars. Turkish J. of Agril. and Natural Sci 2014;1:1097-1100.
23. Vidhyasekaran P. Possible role of ortho-dihyroxy phenolics in grapevine anthracnose disease resistance. Indian J. Expt. Biol 1973;11(5):473-475.