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EFFECT OF ROOTSTOCKS ON YIELD AND WINE QUALITY OF SAUVIGNON BLANC VARIETY

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ABSTRACT

The influence of rootstocks on yield, grape composition, wine quality and sensory evaluation of Sauvignon Blanc was examined during 2022-23 at ICAR-National Research Centre for Grapes, Pune, India. Seven rootstocks (Dogridge, Salt Creek, Fercal, 110R, 140Ru, SO_4 and 1103P) were used for study. Among the rootstocks, yield/vine (7.70 kg), average bunch weight (205.33g), no. of berries/bunch (130.00), 100-berry weight (130.67 g) was significantly higher in Dogridge grafted vine. TSS (24.93 ^{o}Brix) was higher in berries of Dogridge grafted vines; acidity (0.99%), phenol (0.740 mg/g) and tannins (0.467 mg/g) was higher in 140 Ru rootstock; carbohydrates (35.41 mg/g) in Fercal rootstock; reducing sugars was higher in 110R rootstock (23.45 mg/g). While, higher juice recovery was recorded in 1103P rootstock (63.59%). Wine composition like glucose (2.69 g/l), mallic acid (3.2 g/l), total acids (7.3 g/l) was higher in 110R rootstock; volatile acids (0.52 g/l) in 1103P rootstock and phenol content in Salt Creek rootstock (0.79 mg/g). While, colour intensity (0.034) and proline content (11.871 u.mole/g) found higher with SO_4 rootstock. The overall acceptability of wine found better for Sauvignon Blanc vines grafted on 110R rootstock.

Key words : Grafted, Grape, Rootstocks, SB, Vines, Wine quality, Yield.

Introduction

The grapevine (*Vitis vinifera* L.), is one of the most extensively grown fruit crops in the world. Globally, fresh fruit accounts for about 27% of this production (Jin *et al.*, 2016). In India, about 90% of the table grapes are being cultivated. Presently, grapes are grown in India over an area of 1.62 lakh ha with production of 34.45 lakh MT and productivity of 21.00 MT/ha. The major grape growing states in India are Maharashtra (70.67%), Karnataka (24.49%), Tamil Nadu (1.43%), Andhra Pradesh (1.34%), Madhya Pradesh (1.02%) and Mizoram (0.50%) amounting to nearly 99 % of the total production (NHB, 2022). India ranks first in world for grape productivity and secured 7th position in the world for table grape export with the quantum of exported fresh grapes of 2.67 lakh MT worth 2543.42 crores during 2022-23 (APEDA, 2022). However, only about 2% of the total production of grapes is being used for juice and wine purpose.

Under Indian condition, white wine is being preferred more. Sauvignon Blanc, a renowned white wine variety, is famous for its distinct aromatic profile and crisp acidity, making it a prominent cultivar in the production of high-quality wines (Coetzee and Toit, 2012; Louw *et al.*, 2009). The grapevine's growth and performance greatly influenced by its rootstock, which acts as the foundation for its development and nutrient uptake (Migicovsky *et al.*, 2021). Rootstocks are tolerant of varied abiotic stresses (Serra *et al.*, 2014) and resistant to a variety of pests and diseases (Ferris *et al.*, 2012; Hwang *et al.*, 2010). As a result, grafting is a method that is frequently utilized in viticulture. Numerous studies have examined how rootstocks affect the development of vines and the makeup of fruits. However, given to the intricate interactions between rootstocks, scion cultivars, soil and climatic factors, no agreements have yet been established.

In terms of vine vigor, a number of earlier studies found a considerable variation between various grafted vines (Stevens *et al.*, 2008; Koundouras *et al.*, 2009; Wooldridge *et al.*, 2010; Chitarra *et al.*, 2017).

Understanding the effect of different rootstocks on Sauvignon Blanc vines is critical for viticulturists and wine makers striving to optimize grape yield and enhance quality (Dias *et al.*, 2017; Vrsic *et al.*, 2015). The interaction between scion and rootstock can influence several parameters, such as yield, berry composition and the resulting wine's sensory attributes (Olarte Mantilla *et al.*, 2017;). Rootstocks vary in their abilities to modulate vine vigor, water uptake, nutrient assimilation and stress tolerance all of which play pivotal roles in shaping the grapevine and the resulting wine. The study was conducted to evaluate the performance of different rootstocks on the growth, grape yield, and wine quality attributes of Sauvignon Blanc.

Materials and Methods

The study was carried out at National Research Centre for Grapes, Pune (latitude 18°32′N and longitude 73°51′E) during the year 2022-23. Seven years old Sauvignon Blanc grapevines grafted on Dogridge (*Vitis champini*), Salt Creek (*Vitis champini*), Fercal, 110 Richter (*Vitis berlandieri* × *Vitis rupestris*), 140-Ru (*Vitis berlandieri* × *Vitis rupestris*), SO4 (*Vitis berlandieri* × *Vitis riparia*), 1103 Paulsen (*Vitis berlandieri* × *Vitis rupestris*) were evaluated in a randomized block design with three replicates represented by five vines per treatment.

Climate : Pune has sub-tropical and semi-arid climatic conditions with a temperature range of 7.2^{0}C minimum and 37.90^{0}C maximum during trial period. In this region maximum rainfall is received during mid June to September. The total rainfall was 509.60 mm during trial period; south- west monsoon is responsible for major part of annual precipitation. Meteorological data recorded during the period of investigation are presented in Fig. 1.

The rootstocks were chosen mainly on the basis of differences in vigor and genetic origin. The grapevines were spaced at 4 feet between vines and 8 feet between rows, trained on a Mini Y-trellis and were east-west oriented. Double pruning and single cropping pattern is being followed under tropical condition. The foundation pruning was carried out in April, 2022; while fruit pruning in September, 2022. Yield, biochemical and quality parameters were performed after the fruit pruning.

Yield parameters

The total number of bunches were counted from selected five vines in each treatment and mean number of bunches per vine was calculated after berry set (after fruit pruning). The total number of berries were counted from selected five bunches in each treatment and mean number of berries per bunch was calculated. The mean weight of the bunch was recorded by averaging the weight of 3 bunches borne on the five vines selected randomly at harvest. The berries from five vine were collected randomly during harvesting and mean weight of the berry was derived by averaging the weight of 100 berries. The grapes were harvested after attaining the maturity (TSS and acidity). The yield was recorded at the time of harvest.

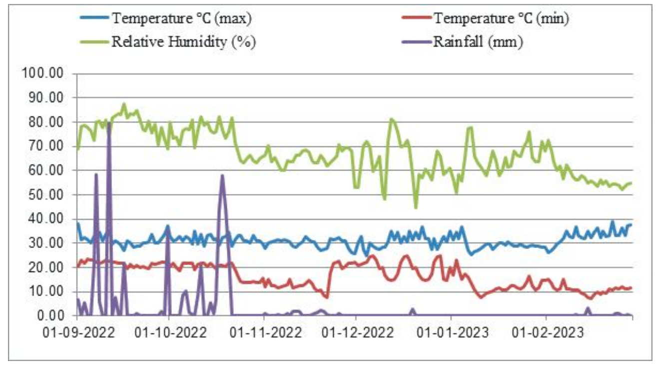

Fig. 1 : Meteorological data recorded during the period of investigation.

Berry Quality parameters

Randomly selected berries were taken for juice extraction and total soluble solids in the juice were determined using hand refractometer. The TSS was measured in degree brix (°Brix). Total titratable acidity was determined by titrating the berry juice with 0.1 N NaOH (Ranganna, 1986). Juice recovery percentage calculated by the following formula:

Juice Recovery Percentage = (W2 / W1) × 100

where,

W1 = Weight of the original fruit or vegetable

W2 = Weight of the juice obtained

Fruit Biochemical parameter

Phenol and tannins was estimated by the method of Folin-Ciocalteu (Singleton and Rossi, 1965) and was expressed in mg/g. The quantity of reducing sugars in the juice was determined by Dinitro-Salicylic acid (DNSA) method (Miller, 1959). A known volume of juice extract was taken, Clear solution was taken for estimation of reducing sugar-using DNSA-reagent by following above method and results were expressed in mg/g.

Wine quality parameters

Wine quality parameters like- volatile acid, mallic acid, total acids, glucose and ethanol per cent of wine sample was measured by FOSS machine. Wine sensory evaluation was done by serving the wine samples to panel comprises 6 individuals. For organoleptic test, 9 point hedonic scale score card contains various wine quality parameters like colour, appearance, flavour, taste and overall acceptability (Cuarto and Magsino, 2017).

The recorded data was analysed using OP STAT statistical software. was used for one-way ANOVA at $p < 0.05$ (student t-test). Origin 2017 software was used for charting.

Results and Discussion

Yield parameters

At harvest, the grape yield was higher on vines grafted on Dogridge rootstock (7.70 kg) and 110-R (6.28 kg/vine) than Fercal (5.90 kg/vine), 140-Ru (5.47 kg/vine), SO4 (5.20 kg/vine), Salt Creek (4.55 kg/vine) and 1103-P (4.18 kg/vine). For vines on the Dogridge rootstock, this difference was mainly due to the higher bunch weight (205.33 g), number of berries per bunch (130.33). However, the higher yield/vines on 110-R grafted vines were due to the higher number of bunches/vine (52.89) compared to other rootstocks (Table 1). According to Bascunan-Godoy *et al*. (2017), yield is mainly correlated to the number of grape clusters, but also the traits of grape clusters and berries, as well as the number of grape berries/clusters. Rives (1971) found that both, the inherent vigor of the scion that conferred by the rootstock were contributing factors to yield performance.

Berry Quality parameters

Berry composition also varied according to the rootstocks. TSS accumulations (24.93 °Brix) were higher and acidity (0.75%) & juice recovery (46.65%) were lower with Dogridge rootstock (Table 2). Total acidity content in the grape juice was moderately correlated with the yield (Pulko *et al*., 2012) while, highest pH (3.53) was recorded in SO4 rootstock, which was statistically non-significant between the rootstocks. Jin *et al*. (2016) found low sugar content and high acidity in the berries from the grafted Sauvignon Blanc vines on SO4 might result in an unbalanced sugar to acid ratio, and thus less attractive to consumers; similar results were reported in the berries of 'Kyoho'/1202C (Chou and Li, 2014). The pH value of the grape juice was not significantly affected by the rootstock (Pulko *et al*., 2012; Kodur *et al*., 2013).

Biochemical parameters

The concentration of total phenols band tannins/gram berry mass was higher in berries collected from plant grafted on 140-Ru rootstock. It appears from the data that grapes from 110-R grafted vines synthesize less phenols (0.707 mg/g) and tannins (0.145 mg/g) and/or broke down more phenols and tannins. This result agrees with recent findings in Shiraz grapes where total tannin concentration of 1103 Paulsen was higher compared to five other rootstocks and vines grown on their own roots (Harbertson and Keller, 2012).

Higher reducing sugar (23.45 mg/g) recorded in berries of 110-R grafted vine and lower reducing sugar recorded in berries of SO4 grafted vine (20.59 mg/g). While, higher carbohydrate content (31.14) found berries of Salt Creek grafted vine and higher juice recovery percent (63.59%) reported with 1103 P grafted vine. The results on biochemical composition exhibited significant difference due to grafting of Sauvignon Blanc on different rootstocks (Somkuwar *et al*., 2014). This could be because different rootstocks have different growth patterns for vines, which affects how those plants absorb water and nutrients from the soil solution. Rootstocks also have different patterns for developing roots. Most secondary, effects of rootstocks are mediated through their influence on vine size and internal canopy shading. According to Satisha *et al*. (2010) reduced glucose and fructose content on 110R and 140Ru rootstock might be due to slower rate of fruit ripening on those rootstocks. The increase in carbohydrate content in the leaf might

Table 1 : Effect of different rootstocks on yield of "Sauvignon Blanc".

Treatments	Average bunch Weight (g)	Berries/bunch	100-berry Weight (g)	Bunches/vine	Yield/vine (kg)
Dogridge	205.33	130.33	130.67	45.24	7.70
Salt Creek	148.00	92.33	111.33	44.15	4.55
Fercal	191.67	106.33	109.33	50.82	5.90
110 R	134.22	100.33	118.00	52.89	6.28
140 Ru	152.56	102.67	116.67	45.26	5.47
SO4	157.67	104.33	118.67	42.04	5.20
1103 P	139.89	92.33	100.00	45.48	4.18
S.Em±	**3.224**	**1.908**	**3.409**	**1.228**	**0.310**
CD at 5%	**9.936**	**5.879**	**10.505**	**3.784**	**0.956**

Table 2 : Effect of different rootstock on berries quality and biochemical parameters of "Sauvignon Blanc".

Treatments	TSS (^{0}Brix)	pH	Acidity (%)	Phenol (mg/g)	Tannin (mg/g)	Reducing sugar (mg/g)	Carbohydrate (mg/g)	Juice recovery %
Dogridge	24.93	3.52	0.75	0.720	0.345	22.75	31.12	46.65
Salt Creek	23.47	3.11	0.88	0.690	0.389	22.73	31.14	49.02
Fercal	23.47	3.14	0.76	0.717	0.147	21.53	35.41	50.43
110 R	23.87	3.22	0.85	0.707	0.145	23.45	23.71	55.54
140 Ru	22.67	3.29	0.99	0.740	0.467	20.64	23.87	46.73
SO4	24.13	3.53	0.91	0.740	0.334	20.59	23.26	61.64
1103P	24.20	3.24	0.83	0.727	0.278	22.45	23.38	63.59
S.Em±	0.112	0.023	0.008	0.012	0.036	0.212	0.094	0.767
CD at 5%	0.344	0.070	0.026	0.036	0.110	0.654	0.290	2.362

Table 3 : Effect of different rootstock on wine quality parameters of "Sauvignon Blanc".

Treatment	TSS (^{0}Brix)	pH	Glucose (g/l)	Mallic acid (g/l)	Volatile acid (g/l)	Total acid (g/l)	Ethanol (%)
Dogridge	6.80	3.54	1.55	1.9	0.44	6.8	13.69
Salt Creek	7.00	3.58	2.05	2.7	0.50	7.0	12.80
Fercal	6.90	3.51	1.04	1.8	0.37	6.9	12.96
110 R	6.87	3.41	2.69	3.2	0.35	7.3	12.78
140 Ru	6.90	3.56	2.57	1.7	0.35	6.7	14.00
SO4	6.33	3.57	1.74	1.8	0.31	5.8	13.01
1103P	7.03	3.58	1.90	1.1	0.52	6.5	13.94
S.Em±	**0.076**	**0.005**	**0.037**	**0.06**	**0.005**	**0.02**	**0.034**
CD at 5%	**0.235**	**0.014**	**0.114**	**0.19**	**0.016**	**0.07**	**0.105**

be due to increase in leaf area that has been resulted in highest activity of photosynthesis rate which helps to synthesis more carbohydrates in the source tissue such as leaf (Somkuwar *et al*., 2014). This study supports the results obtained by Somkuwar *et al*. (2013), who reported potential of a vine to produce carbohydrate to meet the demands of fruit production and vegetative growth based on effective leaf area. In addition, a relationship between variations in vine growth and differences in total phenolic levels has also been reported by Lamb *et al*. (2004) and Cortell *et al*. (2005).

Wine quality parameters

The concentrations of the TSS, pH, glucose, mallic acid, volatile acid, total acid and ethanol were determined. The vines grafted on 1103 P and Salt Creek showed higher concentrations of TSS and pH than other rootstocks grafted wine (Table 3). Glucose content, mallic acid and total acid found significantly higher in wine made from 110 R grafted vines. While, volatile was higher in wine prepared from 1103 P grafted vines. Ethanol percentage was higher in wine prepared from 140-Ru and was statistically similar with wine prepared from 1103-P grafted vines. The non-significant contribution of tartaric acid in influencing juice pH is in accordance to findings of Kodur *et al*. (2013). However, rootstocks significantly affected accumulation of mallic acid in fruits of grafted scions as reported by several workers (Kodur *et al*., 2010, 2011).

Wine Biochemical parameters

The concentrations of the phenol, tannin, colour intensity and proline content were determined and analysed data presented in Table 4. Higher concentration of phenol found in wine prepared from Salt Creek grafted vine, which were observed statistically similar with all other remaining rootstocks. The reduced phenolic compounds on Dogridge rootstock might be due to increased yield per vine, the results were supported by the studies of Cortell *et al*. (2007) and Jogaiah *et al*. (2015).

Higher tannin content in wine recorded with 140-Ru grafted Sauvignon Blanc vine and remaining recorded the respective pattern of Salt Creek>Dogridge> SO4> 1103P> Fercal>110R. In respect to colour intensity of wine, rootstock SO4 found better with higher values for colour intensity than other rootstocks studied. Proline content in wine was significantly higher with SO4

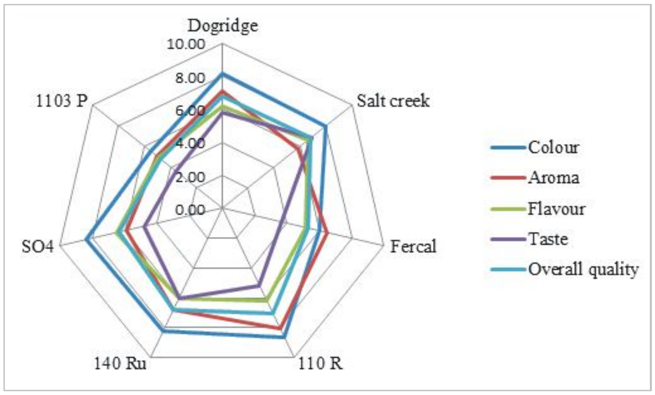

Fig. 2 : Sensory attributes of wine prepared from Sauvignon Blanc grafted on different rootstocks.

Table 4 : Effect of different rootstock on wine biochemical parameters of "Sauvignon Blanc" grafted on different rootstocks.

Treatments	Phenol (mg/g)	Tannin (mg/g)	Colour Intensity (%)	Total proline (u.moles/g)
Dogridge	0.061	0.333	0.0600	1.467
Salt Creek	0.079	0.375	0.0450	4.419
Fercal	0.068	0.142	0.0625	0.907
110 R	0.065	0.140	0.0775	3.219
140 Ru	0.055	0.451	0.0825	3.936
SO4	0.057	0.323	0.0850	11.871
1103 P	0.057	0.268	0.0700	9.302
S.Em±	**0.008**	**0.034**	**0.0036**	**0.2473**
CD at 5%	**0.025**	**0.106**	**0.0112**	**0.7619**

rootstock grafted vines, while other rootstocks shown 1103P> Saltcreek> 140Ru> 110R> Dogridge> Fercal pattern.

Wine sensory parameters

Five wine sensory attributes were significantly different amongst the wine produced from different rootstock (Fig. 2). Wines made from 1103 P grafted vines had lighter colour. Higher aroma of alcohol found in wine prepared from Dogridge grafted vine. Higher sweetness of wine found with Salt Creek grafted SB vines and better flavour found in wine made from berries of Salt Creek grafted vines. While, overall acceptability found in wine prepared from berries of 110R grafted vines and followed in pattern of Salt Creek>Dogridge>140 Ru>>SO_4> Fercal>1103P. According to Wooldridge *et al*. (2010) aroma did not differ between rootstocks. Overall quality was similar in Chardonnay and Pinot noir, but decreased for rootstocks in the sequence: 110R > SO4 > 140Ru. Bravdo *et al*. (1985) found inverse relationship between vigour and wine quality. Teixeira *et al*. (2013) found that molecules of phenolic compounds are responsible for the colour, aromas and flavour of the grapes; consequently, they have a significant impact on the structural properties and sensorial properties of grapes and in particular, astringency in wines.

Conclusion

The results of the present study indicated that the yield, chemical composition of berries and quality of wine prepared from Sauvignon Blanc grapes varied with the rootstock used. Dogridge rootstock recorded significantly higher yield than other rootstocks. Berry quality *i.e*. TSS found higher in berries of Dogridge rootstock; acidity, phenol and tannins recorded higher with 140-Ru rootstock; carbohydrates found higher with Fercal rootstock; reducing sugars recorded higher with 110R rootstock. While, juice recovery found higher with 1103P rootstock. Wine composition parameters like glucose, mallic acid, total acids found higher with 110R rootstock; volatile acids found higher with 1103P rootstock and phenol content found higher with Salt Creek rootstock. While, proline content found higher with SO4 rootstock. Organoleptic test done for wine; overall acceptability of wine found better for 110R grafted vines.

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