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Effect of Different Rootstocks on Raisin Recovery and Quality of Grape Varieties

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ABSTRACT

Performance of three different rootstocks (1103 P, SO_4 and Dogridge) and own root as a control on three varieties (Thompson Seedless, Flame Seedless, Flame Seedless) were studied for raisin recovery and quality of raisins by using dipping-oil method for preparation of raisins. Among the varieties, raisin recovery was best in Thompson Seedless (23.88%) and among the rootstocks, Dogridge (25.14%) showed high percentage of raisin recovery. With respect to qualitative parameters total soluble solids, total sugars, ascorbic acid and reducing sugars, Thompson Seedless showed superior respectively and among the rootstocks, Dogridge performed well. Regarding the quality, the variety Thompson Seedless has shown superior results on rootstock Dogridge.

Key words: *Raisin recovery, Rootstocks, Thompson Seedless, Flame Seedless, Kishmish Chorni.*

INTRODUCTION

Raisin is the most important grape product next to wine referred to as seedless dry grapes. The word 'raisin' derived from the French word 'raisin sec' meaning dry grape[14]. In India, about 78 percent of grape is used for table purpose, nearly 17-20 percent is dried for raisin production, while 1.5 percent is used for juice and only 0.5 percent is used in manufacturing wine and Raisin production is mostly confined to the states of Maharashtra and Karnataka. With increased awareness about the use of rootstocks in overcoming the adverse effects of drought and salinity, growers started using rootstock for the cultivation of grapes. Large quantities of fresh seedless grapes being dumped in the markets during peak season which in turn can be used for processing such as raisin making.

Telangana state is a semi-arid tropical region, wherein the major grape cultivation is confined since decades and as the harvesting period is summer it is the best period for raisin making. Keeping in view of above, the present experiment was proposed to study the effect of different rootstocks on raisin recovery and quality of commercial grape varieties.

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MATERIAL AND METHODS

The study was conducted during 2013-14 in the experimental vineyard of Grape Research Station, Rajendranagar, Hyderabad which falls in semi arid climatic zone. The Research Station is located at 77º 85' E longitude and 18º 45' N latitude and at an altitude of 542.6 m above mean sea level, with the average annual rainfall of 800mm.

The experiment was conducted on a six-year-old orchard, planted at spacing of 10 x 6 ft and trained on "Y trellis system". There were twelve treatments and replicated four times, in a Completely Randomized Factorial Design. One of the factor includes three different varieties of grape (Thompson Seedless, Flame Seedless, Kishmish Chorni) and the other factor includes three different rootstocks (1103 P, SO_4, Dogridge) and own rooted vine.

The influence of rootstocks on raisin recovery and quality parameters viz., recovery of raisins(%), average weight of raisins, moisture(%), total soluble sugars (^{o}Brix), acidity (%), ascorbic acid(mg/100g), total sugars(%), reducing sugars(%), non-reducing sugars(%) was estimated.

Procedure of Raisin preparation and flowchart[4]

Selection of raw material
(Grapes with 20-22°B TSS)
↓
Preparation of bunches
(Removal of diseased, damaged and immature berries)
↓
Washing of grape bunches
(Initially wash with water and soap water and then finally with water)
↓
Thinning of grape bunches
Dipping oil treatment
↓
(Water solution containing 2.5% potassium carbonate and 1.5% ethyl oleate for 3 min., pH 9.5-11)
↓
Drying
(Under shade, dried up to15% moisture content)
↓
Destemming
(Separation of dried grapes from bunches and removal of rachis)
↓
Curing
↓
(Storage in air tight containers for 1 month)

Grading, packing and storage

The harvested grapes were cleaned by removing the dried, damaged, infected and immature berries and trimmed to small bunches. Then bunches were washed in soap water followed by washing in pure water and dipped in dipping oil immediately and 2 kg of grapes per replication was used in all varieties.

DIPPING OIL METHOD

A solution containing 2 percent dipping oil and 2.5 percent potassium carbonate was prepared in a plastic drum. While adding the potassium carbonate the solution was adjusted to 11. The grapes were dipped in this solution for 5 minutes and kept for drying[4].

Recovery of raisins (%)

Before pre treatments, the weight of bunch in each replication for different varieties was recorded using electronic balance. After the completion of dehydration and drying, the actual weight of raisins from each replication was noted. The percent weight of raisins obtained was determined as the recovery of raisins per replication under each variety[1].

Average weight of raisins (g)

After the preparation of raisins, the weight of raisins of each replication was taken and calculated to obtain average weight of raisin[1].

Total soluble solids (^{o} Brix) **of raisins**

The percentage of TSS was determined by using hand refractometer and the values were corrected at 20°C with the help of temperature correction table[8]. For the raisins, the juice was prepared by grinding ten grams of sample from each replication. Then the juice was transferred to volumetric flask and volume made to 100 ml with distilled water. The raisin juice was placed on prism plate to record the visible value on scale and calculated the amount of total soluble solids.

Acidity (%) **of raisins**

Acidity of raisins was estimated by adopting the procedure given by Ranganna[10], For the raisins, ten gram sample was grounded well with little distilled water and volume made up to 100 ml. The contents mashed homogeneously and filtered using whatman No.1 paper. 10 ml filtrate was taken in to conical flask to which two to three drops of phenolphthalein was added as an indicator and

titrated it against 0.1 *N* NaOH till it pink colour as an end point. The titrated acidity was expressed in percentage.

Ascorbic acid of raisins

Ascorbic acid of raisins as determined as mg in 100g sample adopting the 2, 6-Dichlorophenol-Indophenol visual titration method and the reagents were prepared as specified in the method of Ranganna[12].

Sugars of raisins

Reducing sugars, total sugars and non-reducing sugars of raisins were estimated by adopting the Lane and Eynon method[11].

STATISTICAL ANALYSIS

The data was analysed according to procedure of analysis for Factorial Randomized Block Design given by Panse and Sukhatme[9]. The significant variation among the treatments was observed by applying F-test and critical difference (CD) was worked out at 5% level of probability to judge the differences between means of two levels of a factor.

RESULTS AND DISCUSSION

Recovery of raisins

The data presented in table 1, reveals that significant difference was observed on raisin recovery and highest recovery of raisins observed in the varieties grafted on Dogridge rootstock (25.14 %). Among the varieties, highest percentage of raisin recovery was recorded in Thompson Seedless (23.88 %). The interaction effect was found to be significant. Thompson Seedless on Dogridge rootstock recorded (26.67 %) highest percentage of raisin recovery

Among the varieties, Thompson Seedless maximum recovery, it might be due the loss of moisture as it contains more water percentage and high total soluble solids and sugars recorded in fresh berries of Thompson Seedless than other varieties. Similar observation was made by Doreyappa[4].

Table 1: Effect of different rootstocks on recovery of raisins (%) in commercial varieties of grape

Table 1	Recovery of raisins (%)				
	ROOTSTOCKS				
VARIETIES	**1103P**	**SO4**	**Dogridge**	**Ownroot**	**Mean of Varieties**
Thompson Seedless	24.52	22.20	26.67	22.11	**23.88**
Flame Seedless	22.28	19.25	23.18	22.13	**21.96**
Kishmish Chorni	24.38	22.17	25.56	22.05	**23.54**
Mean of Rootstocks	**23.73**	**21.21**	**25.14**	**22.43**	
CD of Rootstocks at 5%	**0.67**			**SEm±**	**0.23**
CD of Varieties at 5%	**0.58**				**0.20**
Rootstock x variety at 5%	**1.17**				**0.40**

Average weight of raisins

Among the varieties maximum weight of raisins was recorded with Flame Seedless (1.00g) which was on par with Thompson Seedless (0.95g). As shown in table 2, it is obvious that average weight of raisins was significantly affected by the kind of rootstock. Varieties grafted on own root (1.06g) was having maximum weight of raisins. The maximum weight was recorded with Flame Seedless on own root (1.21g).

Difference in the weight of raisin may be due to size of berry and sugar content of their fresh berries. This is in controversy with the findings of Winkler[14] and Adsule *et al*.[1]. The difference in raisin moisture level and the skin thickness, among the varieties may be other factors that influence the weight of the raisins.

Table 2: Effect of different rootstocks on average weight of raisins (g) in commercial varieties of grape

Table 2	Average weight of raisins (g)				
	ROOTSTOCKS				
VARIETIES	**1103P**	**SO4**	**Dogridge**	**Ownroot**	**Mean of Varieties**
Thompson Seedless	0.95	0.84	0.87	1.13	**0.95**
Flame Seedless	1.02	0.84	0.91	1.21	**1.00**
Kishmish Chorni	0.85	0.65	0.73	0.88	**0.77**
Mean of Rootstocks	**0.94**	**0.78**	**0.84**	**1.06**	
CD of Rootstocks at 5%	**0.007**			**SEm±**	**0.003**
CD of Varieties at 5%	**0.006**				**0.002**
Rootstock x variety at 5%	**0.012**				**0.004**

TOTAL SOLUBLE SOLIDS (ºBrix) OF RAISINS

Varieties grafted on rootstocks and own roots had significantly influenced total soluable solids and the data is presented in the table 3. Among the varieties significantly highest content of TSS was observed in Thompson Seedless raisins (71.85° B)

Varieties grafted on Dogridge rootstock recorded the highest value of TSS in raisins (71.40° B) and was statistically on par with 1103 P rootstock (70.99° B). Interaction effect was found to be significant. Thompson Seedless grafted on 1103 P rootstock (73.27° B) recorded highest content of TSS in the raisins

The total soluble solids in the varieties ranged from 56.20 to 79.36°B. Similarly Mane *et al*.[6] reported raisin total soluble solids in different varieties ranging from 71.5 to 82.6 °B. In the present study, TSS was more with Thompson Seedless which was accordance with the investigation of Ahmed and Masoud.

Table 3: Effect of different rootstocks on total soluble sugars of raisins (º B) in commercial varieties of grape

Table 3	Total soluble sugars (°Brix)				
	ROOTSTOCKS				
VARIETIES	**1103P**	**SO4**	**Dogridge**	**Ownroot**	**Mean of Varieties**
Thompson Seedless	73.27	69.78	73.06	71.30	**71.85**
Flame Seedless	67.23	65.24	68.89	67.23	**67.15**
Kishmish Chorni	72.46	71.40	72.25	70.95	**71.77**
Mean of Rootstocks	**70.99**	**68.81**	**71.40**	**69.83**	
CD of Rootstocks at 5%	**0.67**			**SEm±**	**0.23**
CD of Varieties at 5%	**0.58**				**0.20**
Rootstock x variety at 5%	**1.17**				**0.40**

Acidity (%) of raisins

The data presented in the table 4 is found to be significant with respect to varieties and rootstock. Among the varieties significantly highest percentage of acidity was observed in raisins of Kishmish Chorni (2.08 %). Raisins prepared from the varieties grafted on SO_4 rootstock recorded the highest percentage of acidity (1.91 %) and was statistically on par with own root (1.87 %).

Interaction effect was found to be significant. Kishmish Chorni on SO_4 rootstock recorded highest percentage (2.25%). The raisin acidity development in the varieties under this experimentation was observed directly proportional to the acidity in fresh grapes. Similar observation was made by Winkler[14], Thimma Reddy[13] also reported that the initial acid content present in berries gets concentrated proportionately in raisins.

Table 4: Effect of different rootstocks on acidity of raisins (%) in commercial varieties of grape

Table 4	Acidity (%)				
	ROOTSTOCKS				
VARIETIES	**1103P**	**SO4**	**Dogridge**	**Ownroot**	**Mean of Varieties**
Thompson Seedless	1.94	1.95	1.71	1.72	**1.83**
Flame Seedless	1.63	1.53	1.52	1.75	**1.61**
Kishmish Chorni	2.00	2.25	1.93	2.13	**2.08**
Mean of Rootstocks	**1.86**	**1.91**	**1.72**	**1.87**	
CD of Rootstocks at 5%	**0.04**			**SEm±**	**0.01**
CD of Varieties at 5%	**0.03**				**0.01**
Rootstock x variety at 5%	**0.07**				**0.02**

ASCORBIC ACID (MG/100G)

Table 5: Effect of different rootstocks on ascorbic acid of raisins (mg/100g) in commercial varieties of grape

Table 5	Ascorbic acid (mg/100g)				
	ROOTSTOCKS				
VARIETIES	**1103P**	**SO4**	**Dogridge**	**Ownroot**	**Mean of Varieties**
Thompson Seedless	23.52	22.47	24.40	20.54	**22.73**
Flame Seedless	19.29	18.63	19.56	18.67	**19.04**
Kishmish Chorni	21.30	20.59	22.12	20.75	**21.19**
Mean of Rootstocks	**21.37**	**20.57**	**22.03**	**19.99**	
CD of Rootstocks at 5%	**0.49**			**SEm±**	**0.17**
CD of Varieties at 5%	**0.42**				**0.15**
Rootstock x variety at 5%	**0.85**				**0.30**

Among the varieties, raisins prepared from Thompson Seedless recorded highest amount of ascorbic acid (22.73 mg/100g) and least content was noticed in raisins of Flame Seedless variety (19.04 mg/100g). Kishmish Chorni showed intermediate results (21.19 mg/100g).

The data recorded in the table 5 was significant and interaction effect was high in varieties grafted on Dogridge rootstock (22.03 mg/100g) which was on par with 1103 P (21.37 mg/100g) and least was on own root (19.99 mg/100g). The influence between varieties and rootstock were significant and highest values are obtained by Thompson Seedless on Dogridge rootstock (24.40 mg/100g) which was on par with Thompson Seedless on 1103 P (23.52 mg/100g) and the least values are obtained from Flame Seedless on SO 4 (18.63 mg/100g)

Total sugars (%) of raisins

The data is presented in the table 6 showed significant results. Among the varieties significantly highest percentage of total sugars was observed in raisins prepared from Thompson Seedless (66.93 %). Varieties grafted on Dogridge rootstock recorded the highest values (68.06 %). Interaction effect was found to be significant. Thompson Seedless on Dogridge rootstock recorded highest percentage (68.5 %) of total solids in raisins while the least percentage was obtained by Flame Seedless on own rooted (63.83 %) vines.

The total sugar content in raisins was observed to be directly proportional to the total soluble solids in the fresh grapes. A similar observation was observed by Mane *et al*.[6]. Gee[5] reported final sugar content of raisins was more when compare to fresh grapes.

Table 6: Effect of different rootstocks on total sugars of raisins (%) in commercial varieties of grape

Table 6	Total sugars (%)				
	ROOTSTOCKS				
VARIETIES	**1103P**	**SO4**	**Dogridge**	**Ownroot**	**Mean of Varieties**
Thompson Seedless	67.53	65.48	68.50	66.20	**66.93**
Flame Seedless	65.15	64.38	67.15	63.83	**65.13**
Kishmish Chorni	66.03	65.55	68.53	67.05	**66.79**
Mean of Rootstocks	**66.23**	**65.14**	**68.06**	**65.70**	
CD of Rootstocks at 5%	**0.21**			**SEm±**	**0.07**
CD of Varieties at 5%	**0.18**				**0.06**
Rootstock x variety at 5%	**0.37**				**0.13**

Reducing sugars (%) of raisins

The data pertaining to reducing sugars of raisins is presented in the table 7. Among the varieties significantly highest percentage of reducing sugars of raisins was observed in Thompson Seedless (66.98 %) and is on par to Kishmish Chorni (62.77 %) and least percentage by Flame Seedless (61.34 %)

Varieties grafted on Dogridge rootstock recorded the highest percentage (64.39 %) of

reducing sugars and was statistically on par with 1103 P (62.35 %) and lowest value was recorded by SO 4 rootstock (61.06 %) and is on par to own rooted vines (61.65 %).

Interaction effect was found to be significant. Kishmish Chorni on Dogridge rootstock recorded highest percentage (65.33 %) of reducing sugars. The least percentage of reducing sugars was obtained by Flame Seedless on SO 4 (60.16 %).

Table 7: Effect of different rootstocks on reducing sugars of raisins (%) in commercial varieties of grape

Table 7	Reducing sugars (%)				
	ROOTSTOCKS				
VARIETIES	**1103P**	**SO4**	**Dogridge**	**Ownroot**	**Mean of Varieties**
Thompson Seedless	64.45	61.58	64.45	61.43	**62.98**
Flame Seedless	61.37	60.16	63.38	60.46	**61.34**
Kishmish Chorni	61.23	61.45	65.33	63.05	**62.77**
Mean of Rootstocks	**62.35**	**61.06**	**64.39**	**61.65**	
CD of Rootstocks at 5%	**0.13**			**SEm±**	**0.04**
CD of Varieties at 5%	**0.12**				**0.04**
Rootstock x variety at 5%	**0.23**				**0.83**

Non-reducing sugars (%) of raisins

The perusal of the data presented in table 8 reveals that non-reducing sugars varied significantly. Among the varieties Kishmish Chorni (4.02 %) recorded the highest percentage of non-reducing sugars this was followed by Thompson Seedless (3.96 %). Among the rootstocks, it can be observed that the highest percentage was recorded with varieties grafted on SO_4 (4.07 %). Interaction effect was found to be significant. The highest percentage was recorded with Kishmish Chorni on 1103 P rootstock (4.08 %).

This may be due to sucrose inversion activity as reported by Clary *et al.*[3] and also may be due to original non reducing sugars content in fresh fruits. Mane *et al*.[6] reported non reducing sugars ranged from 3.50 to 4.8 %.

Table 8: Effect of different rootstocks on non-reducing sugars of raisins (%) in commercial varieties of grape

Table 8	Non-reducing sugars (%)				
	ROOTSTOCKS				
VARIETIES	**1103P**	**SO4**	**Dogridge**	**Ownroot**	**Mean of Varieties**
Thompson Seedless	3.10	3.90	4.05	4.79	**3.96**
Flame Seedless	3.78	4.22	3.77	3.37	**3.79**
Kishmish Chorni	4.80	4.10	3.20	4.00	**4.02**
Mean of Rootstocks	**3.89**	**4.07**	**3.67**	**4.05**	
CD of Rootstocks at 5%	**0.07**			**SEm±**	**0.02**
CD of Varieties at 5%	**0.06**				**0.02**
Rootstock x variety at 5%	**0.13**				**0.04**

CONCLUSION

In this study, the variety Thompson Seedless showed best performance on the rootstock Dogridge regarding raisin recovery and quality. The importance of rootstocks to enhance the quantity and quality components of commercial grape cultivars has to be further studied in varied agro climatic zones and in wide range of soils.

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