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Evaluation of grape genotypes for early ripening and total soluble solid content

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Abstract

Forty-seven grape genotypes were evaluated under subtropical climatic conditions of Delhi, India from 2014-16. All the genotypes were mainly grouped under two categories i.e., seeded and seedless. Each category was further categorized in to white and coloured. These genotypes were consisted of mainly *Vitis vinifera* L. The data were recorded for full bloom, berry ripening, total soluble solids and titratable acidity. The genotype 'ER-R2P36' came in to full bloom earliest. The maximum content of TSS was found in genotype 'ER-R2P36', 'Hy. 76-1', '16/2A-R1P5' which were also ripened early. The least amount of titratable acidity was recorded in was recorded in two genotypes Perlette and Flame Seedless. The maximum TSS/TA ratio was recorded in genotypes 'Hy. 76-1', 'ER-R2P36', 'Perlette.

Keywords: Grape, genotype, full bloom, ripening, TSS, titratable acidity

Introduction

In fruit crops, grape (*Vitis vinifera* L.) is the most and widely grown around the world. Internationally, approximately 23 per cent of the total grapes produced are used fresh consumption and remaining 86.6 per cent goes to processing, mainly for wine-making (Liu *et al.*, 2006) [7]. The commercial viticulture in India is around six-decade old and is currently being considered as one of the most remunerative horticulture enterprises. Large numbers of varieties are being grown from temperate to subtropical climate. Vines are dormant during winter under temperate and subtropical climate area. Good quality berry development requires hot and dry long summer and cool winter. However, both biotic and abiotic factors influence drastically the quality of grapes. The abiotic factors mainly climatic variations accounts for the germplasm variability. The variability with regards to fruit quality is promising for identification of variable genotypes for fresh consumption, juice and wine making. In general, abiotic factors (climatic variations) are more pronounced to alter the berry composition as compared to any other factor (Coombe, 1987) [4]. Jackson and Lombard (1993) [6] elucidated that the climate plays a crucial role in berry maturity, ripening, physico-chemical characteristics. The different growing conditions, varieties and locations also significantly influence the grape maturity and the time of harvest. This is mainly due to the genotypic adaptability to temperature, heat stress, rainfall and its distribution during the season (Cameron and Pasqual, 2004) [3]. Grape growing under sub-tropical climate of north India experience the monsoon rains during berry ripening. This causes berry cracking and failure of crop. Therefore, the early maturing varieties are only suitable for cultivation under such agro-ecological zones. Early maturing varieties escape from pre-monsoon showers and able to yield good yield of quality fruits. The ideal TSS for table grapes considered is 18 degree brix. Therefore, early maturing grapes having about 18 degree brix are ideal for commercial cultivation under sub-tropical climate. The present study, therefore aims to evaluate grape genotypes for identification of early maturing grape genotypes with desirable total soluble solid content.

Materials and Methods

The present investigation was carried out the Division of Fruits and Horticultural Technology, ICAR- Indian Agricultural Research Institute, New Delhi. The site of the vineyards was located in sub-tropical climate region which experienced heavy monsoon rains in summers. Forty-seven grape genotypes were selected for evaluation purpose. The vines were trained to a kniffin system. Bunches were harvested before onset of pre-monsoon showers and nearly harvest maturity. Bunches of uniform size, without injury was sorted out and used for

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analytical work. Four uniform bunches from each three different vines were used for taking morphological and biochemical analysis. Grape berries were removed from each bunch. Date of full bloom was recorded for each marked vines. The TSS of grape juice was recorded with the help of by a digital refractometer (HI 96801, Hanna, Romania). Data was expressed as equivalent Brix. The titratable acidity of the juice present in all the genotypes was determined by titration against 0.1N NaOH solution using a 1-2 drop of phenolphthalein as indicator. The 10 ml sample of the juice was used for analytical work and total volume was make to 100 ml and was filtered through watman filter paper. Out of it 10 ml of aliquot was drawn for titration. The titratable acidity of sample was expressed as per cent tartaric acid (AOAC, 2000). The data were analysed using univariate analysis of variances. The means were compared using Duncan's multiple range test (DMRT). The statistical analysis software SPSS 12 was employed. A difference was considered statistically significant when the p -value was less than 0.05 ($p < 0.05$).

Results and Discussions

The data presented in the Table 1 pertaining to the full bloom recorded at 50% anthesis. Among all the genotypes the full bloom lasted for 15 days (15th to 31st March, 2014). The earliest full bloom was recorded in Hybrid 'ER-R₂P₃₆' (15th March, 2014) followed by Hybrid 'ER-R₁P₁₉' (17th March, 2014), Hybrid 'ER-R₁P₁₆' (17th March, 2014), 'Pusa Trishar' (18th March, 2014), 'Beauty Seedless' (19th March, 2014), 'Flame Seedless' (20th March, 2014), Hybrid 'BA x BS' (19th March, 2014), 'Perlette' (19th March, 2014), Hybrid '16/2A-R₃P₁₀' (19th March, 2014), 'Pusa Aditi' (20th March, 2014), Hybrid '16/2A-R₁P₉' (20th March, 2014), 'Pusa Urvashi' and 'Centennial Seedless' (20th March, 2014). Other genotypes came in to full bloom later and this stage ended in the last week of March. Most delayed full bloom was reported in genotypes 'Chardonnay' (31st March, 20014). In general early full bloom was recorded in the seedless coloured genotypes followed by seedless white genotypes. However, most of the genotypes, which were seeded (coloured or white), bloomed late.

Table 1: Date of full bloom (at 50% blooms) in grape genotypes

Seedless				Seeded			
Coloured		White		Coloured		White	
Genotypes	DFB*	Genotypes	DFB	Genotypes	DFB*	Genotypes	DFB*
ER R ₁ P ₁₉	17 th March	Pusa Aditi	20 th March	<i>V. parviflora</i>	27 th March	Anab-e-Shahi	25 th March
ER-R ₁ P ₁₆	17 th March	Pusa Trishar	18 th March	Black Prince	26 th March	Julesky Muscat	24 th March
ER R ₂ P ₃₆	15 th March	Hy.75-151	22 th March	Punjab Purple	24 th March	Hur	27 th March
Hy. BA x BS	19 th March	16/2A R ₁ P ₁₅	21 th March	Black Muscat	24 th March	Bharat Early	25 th March
Beauty Seedless	19 th March	16/2A R ₁ P ₉	20 th March	Cardinal	21 th March	16/2A R ₂ P ₁₂	22 th March
Flame Seedless	20 th March	16/2A R ₁ P ₁₃	23 th March	16/2A R ₃ P ₁₂	20 th March	ER R ₂ P ₂₈	23 th March
		Tas-e-Ganesh	22 th March	16/2A R ₁ P ₁₄	20 th March	ER R ₁ P ₅	22 th March
		Pusa Seedless	21 th March	16/2A R ₁ P ₁₉	22 th March	Hy.76-1	21 th March
		Pusa Urvashi	20 th March	16/2A R ₄ P ₇	20 th March	Hy.71-50	22 th March
		Centennial Seedless	20 th March	16/2A R ₃ P ₁₀	19 th March	Chardonnay	31 th March
		Perlette	19 th March	Pusa Navrang	22 th March	Sauvignon	30 th March
				16/2A R ₁ P ₁₈	21 th March		
				16/2A R ₄ P ₁₃	22 th March		
				16/14 R ₇ P ₅	23 th March		
				Tempranillo	27 th March		
				Syrah	28 th March		
				Cabernet Sauvignon	29 th March		
				Cabernet	30 th March		
				Merlot	28 th March		

Notes: DFB = Full bloom date. The dates were recorded during the growing season of 2014.

The data related to berry maturity are presented in table 2. The earliest harvesting of bunched was recorded in Hybrid 'ER-R₂P₃₆' followed by 'ER-R₁P₁₆' (3rd week of May), 'ER-R₁P₁₉' (3rd week of May), 'ER-R₁P₅', 'ER-R₂P₂₈', '16/2A-R₁P₁₄', '16/2A-R₃P₁₂', '16/2A-R₁P₉', 'Hy. BA x BS', '16/14-R₇P₅', 'Perlette', 'Centennial Seedless', 'Beauty Seedless',

'16/2A-R₁P₁₃', 'Hy. 76-1', 'Cardinal', 'Flame Seedless', 'Pusa Trishar', 'Pusa Seedless' and 'Pusa Aditi'. However, rest of the genotypes matured in the 2nd week of June, 2014. In general, it was also noticed that the early maturing grape genotypes are of seedless coloured type followed by seedless white and late was recorded in seeded genotypes.

Table 2: Time of berry maturity recorded in grape genotypes

Seedless				Seeded			
Coloured		White		Coloured		White	
Genotypes	DoH	Genotypes	DoH	Genotypes	DoH	Genotypes	DoH
ER R ₁ P ₁₉	1-4 th June	Pusa Aditi	8-12 th June	<i>V. parviflora</i>	12-19 th June	Anab-e-Shahi	12-15 th June
ER-R ₁ P ₁₆	27-30 th May	Pusa Trishar	7-10 th June	Black Prince	14-20 th June	Julesky Muscat	13-15 th June
ER R ₂ P ₃₆	25-28 th May	Hy.75-151	9-14 th June	Punjab Purple	10-19 th June	Hur	12-15 th June
Hy. BA x BS	1-7 th June	16/2A R ₁ P ₁₅	10-16 th June	Black Muscat	14-17 th June	Bharat Early	12-16 th June
Beauty Seedless	5-8 th June	16/2A R ₁ P ₉	1-6 th June	Cardinal	6-10 th June	16/2A R ₂ P ₁₂	16-22 nd June
Flame Seedless	7-15 th June	16/2A R ₁ P ₁₃	5-9 th June	16/2A R ₃ P ₁₂	1-5 th June	ER R ₂ P ₂₈	1-4 th June
		Tas-e-Ganesh	9-13 th June	16/2A R ₁ P ₁₄	1-4 th June	ER R ₁ P ₅	1-3 rd June
		Pusa Seedless	7-12 th June	16/2A R ₁ P ₁₉	9-11 th June	Hy.76-1	6-10 th June
		Pusa Urvashi	10-15 th June	16/2A R ₄ P ₇	16-20 th June	Hy.71-50	13-19 th June

	Centennial Seedless	3-7 th June	16/2A R ₃ P ₁₀	15-20 th June	Chardonnay	17-21 st June
	Perlette	4-7 th June	Pusa Navrang	6-10 th June	Sauvignon	21-25 th June
			16/2A R ₁ P ₁₈	15-20 th June		
			16/2A R ₄ P ₁₃	14-20 th June		
			16/14 R ₇ P ₅	3-7 th June		
			Tempranillo	10-12 th June		
			Syrah	12-15 th June		
			Cabernet Sauvignon	16-19 th June		
			Cabernet	18-21 st June		
			Merlot	21-25 th June		

Notes: DoH = Date of harvest. The dates were recorded during the growing season of 2014.

The TSS values ranged from 22.00°Brix ('Bharat Early') to 13.23°Brix ('Anab-e-Shahi'). In terms of higher TSS content some of the good quality grape genotypes were identified are 'ER-R₂P₃₆' (21.25°Brix), 'Hy. 76-1' (21.15 °Brix), '16/2A-R₁P₅' (20.18 °Brix), 'Tempranillo' (20.13°Brix), 'Merlot' (19.13 °Brix), 'Pusa Navrang' (19.60°Brix), '16/2A-R₂P₁₂' (19.50°Brix), 'Pusa Trishar' (19.03°Brix), '16/2A-R₄P₇' (18.85°Brix), 'Perlette' (18.83) and 'Centennial Seedless' (18.55 °Brix). It is clearly evident from the data that the maximum TSS was recorded in the seeded white genotypes (18.72°Brix) followed by seeded coloured (17.66°Brix),

seedless coloured (17.74°Brix) and seedless white (17.40°Brix). However, this character is genotype specific and controlled by quantitative genes. Therefore, these trends among the different groups do not depict real association.

The berry juice acidity ranged from 0.58% to 1.09%. The minimum acidity value (0.58%) was recorded in 'Perlette' and 'Flame Seedless'. Whereas, the maximum acidity was found in 'Cabernet Sauvignon' (1.09%) followed by '16/2A-R₃P₁₂' & '16/2A-R₁P₁₉' (1.05% each), 'Merlot' & 'Centennial Seedless' (1.01% each) and 'Sauvignon' (1.00%). Other had intermediate juice acidity (Table 4).

Table 3: Total soluble solids (°Brix) content of grape genotypes

Seedless				Seeded			
Coloured (a)		White (b)		Coloured (c)		White (d)	
Genotype	TSS	Genotype	TSS	Genotype	TSS	Genotype	Mean
ER R ₁ P ₁₉	16.33	Pusa Aditi	15.30	<i>V. parviflora</i>	14.35	Anab-e-Shahi	13.23
ER-R ₁ P ₁₆	14.68	Pusa Trishar	19.03	Black Prince	18.23	Julesky Muscat	18.10
ER R ₂ P ₃₆	21.25	Hy.75-151	15.95	Punjab Purple	17.90	Hur	17.18
Hy. BA x BS	18.38	16/2A R ₁ P ₁₅	15.63	Black Muscat	16.75	Bharat Early	22.00
Beauty Seedless	17.95	16/2A R ₁ P ₉	17.13	Cardinal	16.95	16/2A R ₂ P ₁₂	19.50
Flame Seedless	17.85	16/2A R ₁ P ₁₃	18.38	16/2A R ₃ P ₁₂	17.78	ER R ₂ P ₂₈	17.75
		Tas-e-Ganesh	17.78	16/2A R ₁ P ₁₄	17.98	ER R ₁ P ₅	20.18
		Pusa Seedless	17.85	16/2A R ₁ P ₁₉	17.88	Hy.76-1	21.15
		Pusa Urvashi	17.05	16/2A R ₄ P ₇	18.85	Hy.71-50	18.86
		Centennial Seedless	18.55	16/2A R ₃ P ₁₀	17.35	Chardonnay	19.50
		Perlette	18.83	Pusa Navrang	19.60	Sauvignon	18.58
				16/2A R ₁ P ₁₈	17.75		
				16/2A R ₄ P ₁₃	17.45		
				16/14 R ₇ P ₅	16.10		
				Tempranillo	20.13		
				Syrah	18.78		
				Cabernet Sauvignon	14.45		
				Cabernet	18.10		
				Merlot	19.13		
Group mean	17.74	-	17.40	-	17.66	-	18.72
Mean of a, b, c, d					17.50		
LSD (p ≤0.05)					0.83		

Table 4: Total Titratable acidity (%) of grape genotypes

Seedless				Seeded			
Coloured (a)		White (b)		Coloured (c)		White (d)	
Genotype	TTA	Genotype	TTA	Genotype	TTA	Genotype	TTA
ER R ₁ P ₁₉	0.69	Pusa Aditi	0.83	<i>V. parviflora</i>	0.80	Anab-e-Shahi	0.60
ER-R ₁ P ₁₆	0.65	Pusa Trishar	0.96	Black Prince	0.80	Julesky Muscat	0.60
ER R ₂ P ₃₆	0.68	Hy.75-151	0.93	Punjab Purple	0.73	Hur	0.70
Hy. BA x BS	0.75	16/2A R ₁ P ₁₅	0.65	Black Muscat	0.59	Bharat Early	0.99
Beauty Seedless	0.90	16/2A R ₁ P ₉	0.65	Cardinal	0.65	16/2A R ₂ P ₁₂	0.70
Flame Seedless	0.58	16/2A R ₁ P ₁₃	0.73	16/2A R ₃ P ₁₂	1.05	ER R ₂ P ₂₈	0.75
		Tas-e-Ganesh	0.77	16/2A R ₁ P ₁₄	0.85	ER R ₁ P ₅	0.90
		Pusa Seedless	0.67	16/2A R ₁ P ₁₉	1.05	Hy.76-1	0.65
		Pusa Urvashi	0.70	16/2A R ₄ P ₇	0.74	Hy.71-50	0.59
		Centennial Seedless	1.01	16/2A R ₃ P ₁₀	0.85	Chardonnay	0.71
		Perlette	0.58	Pusa Navrang	0.85	Sauvignon	1.00
				16/2A R ₁ P ₁₈	0.93		

				16/2A R ₄ P ₁₃	0.84		
				16/14 R ₇ P ₅	0.85		
				Tempranillo	0.60		
				Syrah	0.69		
				Cabernet Sauvignon	1.09		
				Cabernet	0.79		
				Merlot	1.01		
Group mean	0.70	-	0.80	-	0.80	-	0.70
Mean of a, b, c, d	0.76						
LSD (p < 0.05)	0.11						

There were significant variations were recorded among the genotypes. It was ranged from 13.26 ('Cabernet Sauvignon') to 32.54 ('Hy. 76-1'). In general, higher ratio was recorded in seedless (24.17) as compared to seeded (22.86) genotypes. Similarly, white genotypes were recorded with higher TSS/TA ratio (23.99) as compared to coloured (23.03) genotypes. However, among genotypes, the maximum TSS/TA ratio was recorded in genotype 'Hy. 76-1' (32.54) followed by 'ER-R₂P₃₆' (31.25), 'Perlette' (28.67), 'Black Muscat' (28.39), 'Chardonnay' (27.46), 'Pusa Seedless' (26.64), '16/2A-R₁P₉' (26.35) and 'Hy. 71-50' (26.05). The minimum TSS/TA ratio was recorded in genotype 'Cabernet Sauvignon' (13.26) followed by '16/2A-R₁P₁₉' (17.03), 'Hy. 75-151' (17.15), '*V. parviflora*' (17.94), 'Centennial Seedless' (18.37) and '16/14-R₇P₅' (18.94).

Early flowering is the desirable trait for a subtropical grape which is influenced by climatic conditions particularly temperature. In subtropical areas flowering occurs during spring season. Various researchers reported variation in flowering behaviour of different grape genotypes under varying climatic conditions (Bharat 1997; Prasad 1971; Huang and Lu 2000) [2, 8, 5]. The grape harvesting time also varied considerably among all the genotypes and results revealed that only few genotypes matured in the last week of May (extra-early maturing type) and majority of genotypes matured in 1st fortnight of June under sub-tropical climatic conditions of Delhi. The short period of maturity may be due to the fact that the phenological stages under the subtropical conditions completed in a shorter period and this acceleration may be due to high mean day and night temperatures, which also favoured the growth and shortened the phenological stage. Similar findings were also reported about variation in maturity time in grapes grown under subtropical conditions of Punjab (Thakur *et al.*, 2008) [9]. The total soluble solids, titratable acidity, and TSS/TA ratio of the berries were differed significantly. The similar findings about TSS and acidity were reported by Thakur *et al.* (2008) [9] in grape grown under Punjab conditions. They reported that TSS/TA ratio is primarily governed by genetical and phenotypical factors and temperature of day and night favours the accumulation of solutes. Therefore, it may be responsible for solute accumulations.

Conclusion

The early full bloom and early berry ripening was recorded in the seedless coloured genotypes as compared to seeded grape genotypes. The genotype 'ER-R₂P₃₆' came in to full bloom earliest, while 'Chardonnay' was most late. In 16 genotypes, more than 18^oBrix TSS was observed. The maximum content was found in genotype 'ER-R₂P₃₆', 'Hy. 76-1', '16/2A-R₁P₅' which also ripened early. The least amount of titratable acidity (0.58%) was recorded in was recorded in two genotypes Perlette and Flame Seedless. The maximum TSS/TA ratio (>26) was recorded in genotypes 'Hy. 76-1',

'ER-R₂P₃₆', 'Perlette', 'Black Muscat', 'Chardonnay', 'Pusa Seedless', '16/2A-R₁P₉' and 'Hy. 71-50'.

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