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Arvind Kumar
Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Jeetendra Kumar
College of Biotechnology, Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Satya Prakash
Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture&Technology, Meerut, Uttar Pradesh, India

Vipin Kumar
Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Corresponding Author:
Jeetendra Kumar
College of Biotechnology, Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, India

Studies on biochemical parameters of Pomegranate (*Punica granatum* L.) with special reference to red aril cultivars

Arvind Kumar, Jeetendra Kumar, Satya Prakash and Vipin Kumar

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Abstract
The present investigation was conducted at Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut to find out the promising cultivars of pomegranate on the basis of biochemical perameters. The maximum level of TSS was measured in cv. Ganesh (14.71^{0}brix) followed by cv. Arakta (13.84^{0}brix) and cv. G-137 (12.71^{0}brix). Out of the eight cultivars studied, significantly maximum level of total sugars was found in cv. Arakta (12.98 %) followed by cv. Mridula (12.36 %) and cv. Ganesh (12.33 %). The level of titrable acidity was found to be significantly lowest in cv. Jalore Seedless (0.30 %) followed by cv. Mridula (0.31). In the present study, maximum TSS:Acid ratio was observed in cv. Ganesh (45.96) followed by cv. G-137 (41.00) and cv. Jalore Seedless (40.73). Maximum Sugar:Acid ratio was found in cv. Mridula (39.87) closely followed by cvs. Jalore Seedless (39.40), Ganesh (38.53) and Arakta (38.17).

Keywords: Pomegranate, cultivars, fruit quality, biochemical parameters

Introduction
Pomegranate (*Punica granatum* L.) is one of the important fruit crop suitable for growing in arid and semi-arid regions owing to its versatile adaptability, hardy nature, low maintenance cost and high yield. Pomegranate is liked for its cool refreshing juice, nutritional and medicinal properties. There is a growing demand for good quality fruits both for fresh use and processed products (Pruthi and Saxena, 1984) [5]. This fruit crop has wide adaptability and it grows well in tropical, sub-tropical and even temperate regions. However, in Uttar Pradesh, particularly in western region of the state,the suitable cultivar of pomegranate has not been identified for commercial cultivation so far. Unlike other major fruit crops, there are few cultivars of pomegranate which are grown commercially in India. It has been observed that performance of commercial cultivars of pomegranate is location specific and various problems like unfavourable environmental conditions, improper cultural techniques, excess moisture condition etc. lead to poor yield.
In view of above facts and considering the potential of pomegranate in the western plain zone of Uttar Pradesh, the present study was carried out to evaluate the performance of different cultivars of Pomegranate under the climatic conditions of western Uttar Pradesh on the basis of biochemical parameters.

Materials and Methods
The present investigation was conducted at Horticutural Research Centre (HRC) of the Department of Horticulture, Sardar Vallabhbhai Patel University of Agriculture & Technology- Meerut, during 2015-2016. The experiment consist eight cultivars of pomegranate. The experiment was conducted using randomized block design (RBD) with five replications in each cultivar/treatment. The cultivars were considered as a factor and each plant under study as a replication. Eight cultivars of Pomegranate namely G -137, Arakta, Phulerakta, Ganesh, Jalore Seedless, Mridula, Muskat Red & Bhagwa were studied. The cv. Ganesh was used as a standard cultivar to find out the performance of other cultivars over this cultivar. The data were recorded on 3 year old plants of different cultivars of pomegranate on biochemical parameters *viz*., Total soluble solids, Acidity and Total sugars.

Results and Discussion

Among the pomegranate cultivars studied, the soluble solids in different pomegranate cultivars ranged from 8.81^0 brix to 14.71 ^{0}brix. The maximum level of TSS was measured in cv. Ganesh (14.71^0 brix) followed by cv. Arakta (13.84^0 brix) and cv. G-137 (12.71^0 brix), while minimum TSS was estimated in cv. Mridula (8.81^0 brix) (Table 1 & Fig. 1). The variation in TSS among pomegranate cultivars depends upon the stage of maturity and ripening of fruit, genetic constitution of cultivars, orchard management practices, environmental conditions etc. Even in the same cultivar wide variation in TSS is measured at different stages of maturity and ripening of fruit. Increase in TSS in fruit during ripening might be associated with the transformation of pectin substances, starch, ripening hemi-cellulose or other polysaccharides in soluble sugar and dehydration of fruit (Singh 2009) [6]. The total soluble solids content in pomegranate cultivars measured by Meena 2003 [4], Wani *et. al.*2014 [7], Akbarpoul *et al.* 2009 were also in the range of 11.11 to 16.38 ^{o}brix, 12.82 to 13.87 ^{o}brix and 15.17 to 22.03 ^{o}brix, respectively.

Out of the eight cultivars studied, significantly maximum level of total sugars was found in cv. Arakta (12.98 %) followed by cv. Mridula (12.36 %) and cv. Ganesh (12.33 %). However, the lowest level of total sugars was recorded in cv. Muskat Red (11.44 %) (Table 2 & Fig. 2). The level of total sugars estimated by these researchers was in the similar range (8.55 to13.76 %) as estimated in the present study. In general, the variation in these chemical compositions might be either due to genetic makeup of the different genotypes, photosynthetic efficiency of different cultivars or due to variation in agro-climatic condition as reported by Khodadi *et.al.* 1990 [3], Bist *et al.* 1994 [2] and Singh 2009 [6]. Wide variation in total sugars in fruits of different pomegranate cultivars was also reported by Meena 2003 [4], and Wani *et. al.* 2014 [7].

The titrable acidity analyzed in eight cultivars ranged from 0.30 % to 0.34 %. The level of titrable acidity was found to be significantly lowest in cv. Jalore Seedless (0.30 %) followed by cv. Mridula (0.31), while the highest level of titrable acidity (0.34 %) was recorded in cvs. Arakta and Bhagwa (Table 3 & Fig.3). Meena 2003 [4] and Akbarpour *et. al.* 2009 while studying the fruit quality attributes had also observed wide variation in acidity content in different pomegranate cultivars. However, acidity content did not vary significantly in cvs. Arakta and Bhagwa in the present study.

In the present study, maximum TSS:Acid ratio was observed in cv. Ganesh (45.96) followed by cv. G-137 (41.00) and cv. Jalore Seedless (40.73), while cv. Mridula (28.41) had minimum TSS:Acid ratio (Table 4 & Fig. 4). Data showed significant variation in TSS/Acid ratio in different pomegranate cultivars studied in the present study. Meena 2003 [4] also observed significant variation in TSS/Acid ratio (11.82 to 47.71 %) in pomegranate cultivars.

Maximum Sugar:Acid ratio was recorded in cv. Mridula (39.87) followed by cvs. Jalore Seedless (39.40), Ganesh (38.53) and Arakta (38.17). However, cv. Bhagwa had lowest Sugar:Acid ratio (33.88) (Table 5 & Fig. 5). A number of reports are available which indicated that chemical composition of pomegranate fruit was significantly varied from cultivar to cultivar.

Based on the results obtained on biochemical attributes of different pomegranate cultivars in the present study, cvs. Ganesh and Arakta were found promising over other cultivars in respect of TSS, acidity and total sugar contents in fruits.

Table 1: Total soluble solids in pomegranate cultivars

S. No.	Cultivars	Total soluble solids (^{0}brix)	Increase or decrease in total soluble solids over Ganesh	Percent increase (+) or decrease (-) in total soluble solids over Ganesh
1.	Ganesh	14.71	-	-
2.	Arakta	13.84	(-) 0.87	(-) 05.91
3.	Phulerakta	11.75	(-) 2.96	(-) 20.12
4.	G -137	12.71	(-) 2.00	(-) 13.59
5.	Jalore Seedless	12.22	(-) 2.49	(-) 16.92
6.	Mridula	08.81	(-) 5.90	(-) 40.10
7.	Muskat Red	10.52	(-) 4.19	(-) 28.48
8.	Bhagwa	10.11	(-) 4.60	(-) 31.27
Mean		11.83	-	-
S.Em. ±		0.2857	-	-
C.D at 5 %		0.8276	-	-

Table 2: Total sugars content in pomegranate cultivars

S. No.	Cultivars	Total sugar (%)	Increase or decrease in total sugars over Ganesh	Percent increase (+) or decrease (-) in total sugars over Ganesh
1.	Ganesh	12.33	-	-
2.	Arakta	12.98	(+) 0.65	(+) 5.27
3.	Phulerakta	11.84	(-) 0.49	(-) 3.97
4.	G -137	11.62	(-) 0.71	(-) 5.75
5.	Jalore Seedless	11.82	(-) 0.51	(-) 4.13
6.	Mridula	12.36	(+) 0.03	(+) 0.24
7.	Muskat Red	11.44	(-) 0.89	(-) 7.21
8.	Bhagwa	11.52	(-) 0.81	(-) 6.56
Mean		11.98	-	-
S.Em. ±		0.19521	-	-
C.D at 5 %		0.56549	-	-

Table 3: Titrable acidity content in pomegranate cultivars

S. No.	Cultivars	Titrable acidity (%)	Increase or decrease in Titrable acidity over Ganesh	Percent increase (+) or decrease (-) in titrable acidity over Ganesh
1.	Ganesh	0.32	-	-
2.	Arakta	0.34	(+) 0.02	(+) 6.25
3.	Phulerakta	0.33	(+) 0.01	(+) 3.12
4.	G -137	0.31	(-) 0.01	(-) 3.12
5.	Jalore Seedless	0.30	(-) 0.02	(-) 6.25
6.	Mridula	0.31	(-) 0.01	(-) 3.12
7.	Muskat Red	0.32	0	0
8.	Bhagwa	0.34	(-) 0.02	(-) 6.25
Mean		0.32	-	-
S.Em. ±		0.01	-	-
C.D at 5 %		0.02	-	-

Table 4: TSS: Acid ratio in pomegranate cultivars

S. No.	Cultivars	TSS:Acid ratio	Increase or decrease in TSS:Acid ratio over Ganesh	Percent increase (+) or decrease (-) inTSS:Acid ratio over Ganesh
1.	Ganesh	45.96	-	-
2.	Arakta	40.70	(-) 05.26	(-) 11.44
3.	Phulerakta	35.60	(-) 10.36	(-) 22.54
4.	G -137	41.00	(-) 04.96	(-) 10.79
5.	Jalore Seedless	40.73	(-) 05.23	(-) 11.37
6.	Mridula	28.41	(-) 17.55	(-) 38.18
7.	Muskat Red	32.87	(-) 13.09	(-) 28.48
8.	Bhagwa	29.73	(-) 16.23	(-) 35.31
Mean		36.87	-	-
S.Em. ±		0.495	-	-
C.D at 5 %		1.433	-	-

Table 5: Sugar: Acid ratio in pomegranate cultivars

S. No.	Cultivars	Sugar:Acid ratio	Increase or decrease in Sugar:Acid ratio over Ganesh	Percent increase (+) or decrease (-) in Sugar:Acid ratio over Ganesh
1.	Ganesh	38.53	-	-
2.	Arakta	38.17	(-) 0.36	(-) 00.93
3.	Phulerakta	35.87	(-) 2.66	(-) 06.90
4.	G -137	37.48	(-) 1.05	(-) 02.72
5.	Jalore Seedless	39.4	(+) 0.87	(+) 02.25
6.	Mridula	39.87	(+) 1.34	(+) 03.47
7.	Muskat Red	35.75	(-) 2.78	(-) 07.21
8.	Bhagwa	33.88	(-) 4.65	(-) 12.06
Mean		37.36	-	-
S.Em. ±		0.00242	-	-
C.D at 5 %		0.00701	-	-

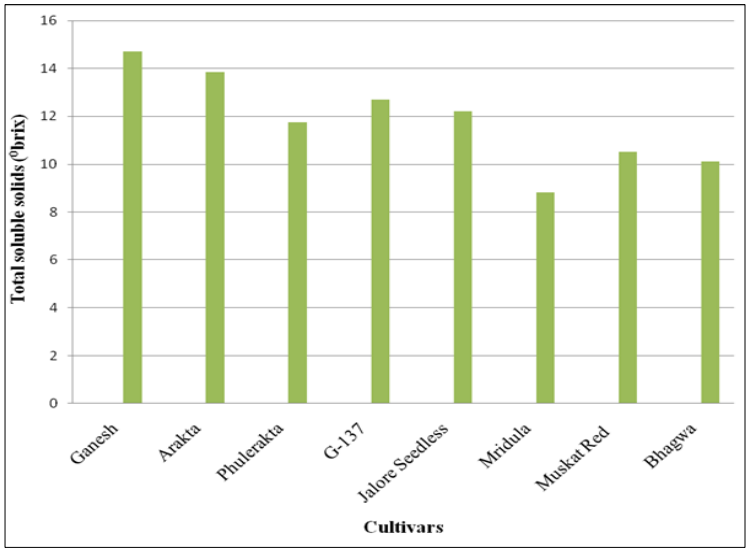

Fig 1: Total soluble solids in pomegranate cultivars

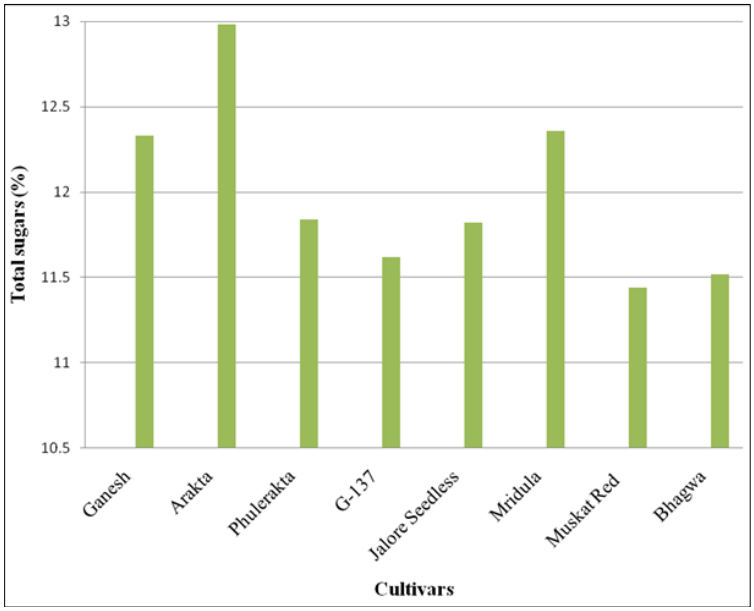

Fig 2: Total sugars content in pomegranate cultivars

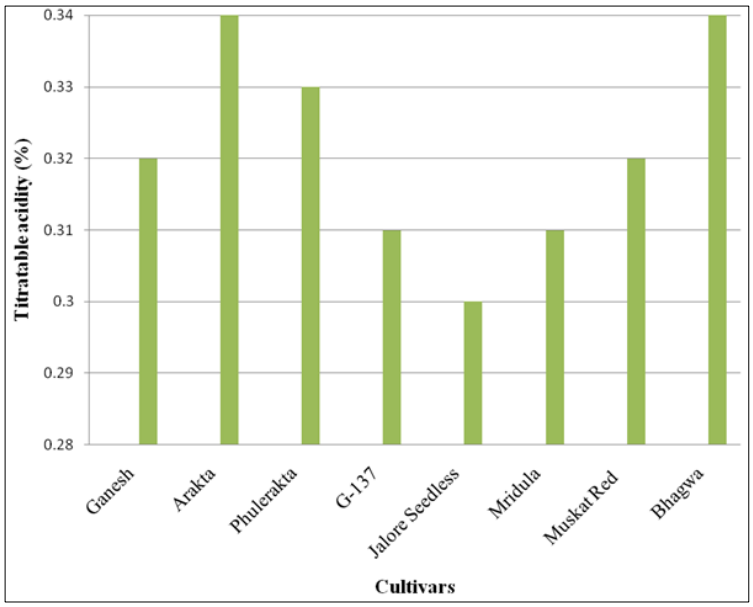

Fig 3: Titrable acidity content in pomegranate cultivars

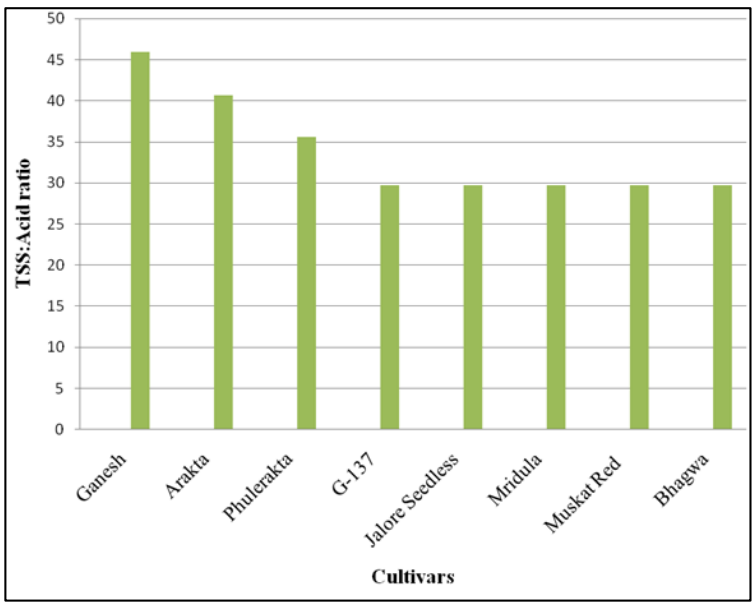

Fig 4: TSS:Acid ratio in pomegranate cultivars

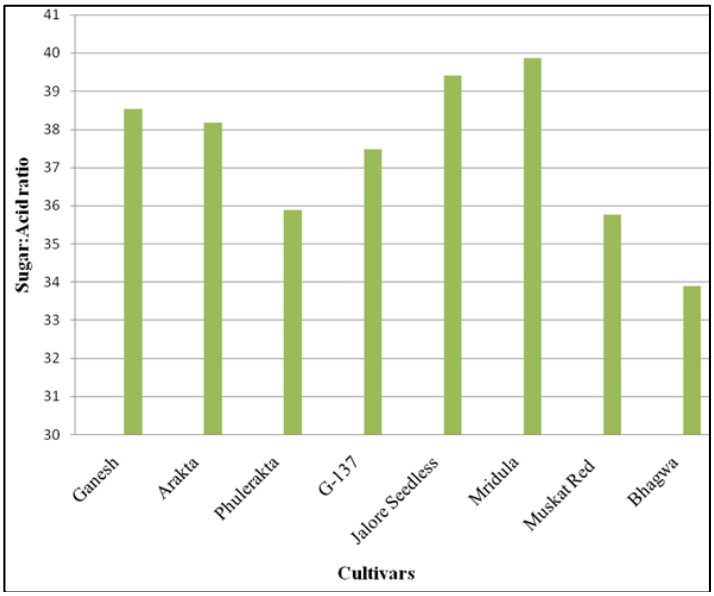

Fig 5: Sugar: Acid ratio in pomegranate cultivars

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