

Characterization and Evaluation of Pomegranate (*Punica granatum* L.) Germplasm under Indian Arid Ecosystem

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Thirty accessions/genotypes collected from various sources and propagated vegetatively were planted in spacing of 5m x 5m to describe and select superior pomegranate genotypes suitable for arid ecosystem of India. The following phenological growth and yielding characteristics were evaluated: tree height, tree spread, suckering, girth, leaf length and width, leaf tip, leaf base, leaf shape, thorn length, size of flowers, TSS, acidity, juice (%), fruit cracking, seed hardness, juice flavour, arid colour. Substantial variability was recorded among the genotypes/varieties. Pomegranate genotypes suitable to the specific soil and climate conditions of Indian arid region are described in detail for their morphological characteristics and physico chemical parameters of the fruits.

Key Words: Arid fruits, Conservation, Genotypes, *Punica granatum*, Variability

Introduction

The genus *Punica* has two species, *Punica protopunica* and *Punica granatum* and is cultivated in tropical and sub tropical areas of the world. Further *Punica granatum* has been classified in to two sub species, *chlorocarpa* and *porphyrocarpa*. Several types of pomegranate distinguished by shape of the fruit, colour and thickness of the skin, and taste and colour of the seed are grown throughout the world.

The fruit is known to have been cultivated in the Middle East more than 5000 years ago. However, wild pomegranate still exists in the North of Syria (Sexana *et al.*, 1987) and in the Himalayan belt of India (Himachal Pradesh, Jammu & Kashmir, Uttaranchal). The fruit was featured in Egyptian mythology and art, praised in the old testaments of the Bible and in the Babylonian Talmud and it was carried by desert caravans for the sake of thirst quenching juices. It traveled to central and southern India from Iran about the first century AD and was reported growing in Indonesia in 1416. There are some commercial orchards in Israel on coastal plains and in the Jordan valley (Morton, 1987). It is found in various regions from Caucasus to Afghanistan. The wild type in Central Asia shows a wide range of variation in size of fruit, sweetness, time of ripening and proportion of seeds to flesh (Adsule and Patil, 1995). Pomegranate is grown as commercial crop in India and Iran, and is cultivated extensively in Spain, Morocco, Egypt, Afghanistan and Baluchistan. It is also grown to some extent in Burma, China, Japan and parts of the United States. The demand for pomegranate fruits for both local

and export market has motivated producers, mainly in the sub tropical and semi-arid-areas of the Indian peninsula (Prasad *et al.*, 1997).

Pomegranate stands out with high potential for economic exploitation due to proven importance for manufacture of juice, syrup, jam/rub as well as for consumption as fresh fruit. It has enjoyed a reputation for its healthy dietic and medicinal properties. Versatile adaptability, hardy nature, low orchard management cost, high yields and excellent keeping quality had made this fruit most lucrative and remunerative (Dhandhar and Singh, 2002). The pomegranate fruits have therapeutical value, good keeping quality and export potential.

However, few studies have been made to classify or identify types with desirable botanical and agronomical characteristics and their suitability under different ecosystems (Fadavi *et al.*, 2005; Singh, 2004; Prasad and Bunker 1999; Bunker and Prasad 1992; Umrao and Singh, 1995; Feng-YZ *et al.*, 1998; Levin 1994).

In spite of rich diversity existing in nature, available variability in gene banks is necessary for utilization. Therefore, it is still necessary to carry out selection of superior cultivars adapted to the area, as their edaphoclimatic characteristics are quite unique. The present study was taken for characterization and evaluation of promising types of pomegranate trees specific to arid and semi arid ecosystem of India and to develop National Repository and their further exploitation for improvement in terms of quality and production.

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Materials and Methods

This work pertaining to development of National Repository for conservation, characterization and evaluation of pomegranate germplasm was conducted at Central Institute of Arid Horticulture, Bikaner, Rajasthan, India. Climate is arid with scanty rainy season in monsoon and with an average minimum and maximum temperature of -2.5°C in winter and 50.0°C in summer (Goyal, 2004). The germplasm collection of 31 varieties/accessions *i.e.* Jalore Seedless, Ganesh, P-26, Mridula, G-137, Jodhpur Red, Kabul, GKVK 1, Dholka, Coimbatore White, P-23, Yarcuad, Muskat, Patna-5, Jyoti, Bedana Thin Skin, Kurvi-2EL-24685, Speen Danedar, Basein Seedless, Kazaki Anar, Khog, AK Anar, Bocheka lines, Gul-e-Shah, Sirin Anar, Dorseta malus, Tabest, Kali Sirin and Tujetis EC-104347 each of which is represented in replication of 3 by plants. The germplasm was collected in the form of vegetative stock obtained by cuttings and air layering. The experimental plot was planted during 1995-96 with planting material obtained from germplasm

collection of experimental stations of various National Institutes in India located in diverse climatic conditions and Exotic germplasm from Argentina, Russia, Iran, California. These were planted in the spacing of 5m x 5m. All the recommended agricultural practices for pomegranate such as fertilizer application, weed control, pest/disease management were carried out manually.

During experimental study from 2000 to 2003 data on plant growth and developmental characteristics of tree *i.e.* tree height, tree spread, suckering, girth, leaf length and width, leaf tip, leaf base, leaf shape, thorn length, size of flowers and physico chemical composition of fruits *i.e.* TSS, acidity, juice (%), fruit cracking, seed hardness, juice flavour, aril colour were recorded. A sample of 10 ripe fruits was used to determine characteristics and composition. TSS determination was achieved by means of direct refractometer reading while mean fruit weight was obtained by dividing plant yield by total number of fruits.

Table 1. Tree growth characteristics of pomegranate germplasm

Genotype	Type of planting material	Tree height (m)	Girth of tree (cm)	Tree spread (m)		Suckering
				Across row	Along row	
Jalore Seedless	EG	2.21	4.20	2.30	2.30	Less
Ganesh	EG	2.18	4.00	2.25	2.30	Less
Bedana Suri	EG	1.90	3.88	1.70	1.91	Less
P-26	EG	2.10	4.47	2.20	2.51	Less
Mridula	EG	2.00	3.80	2.30	2.00	Less
G-137	EG	2.18	4.30	2.25	2.50	Less
Jodhpur Red	EG	2.50	4.00	2.75	2.75	Less
Kabul	EG	2.30	4.40	2.60	3.10	Less
GKVK 1	EG	1.80	3.90	2.30	2.40	Less
Dholka	EG	2.34	4.00	2.00	2.05	Less
Coimbatore White	EG	2.20	3.50	2.30	2.50	Very Less
P-23	EG	2.20	4.10	2.60	2.40	Less
Yarcuad	EG	2.25	4.48	2.35	2.40	Less
Muskat	EG	2.00	3.85	2.10	2.40	Less
Patna-5	EG	1.89	3.71	2.16	2.05	Less
Jyoti	EG	2.08	5.45	2.37	2.68	Less
Bedana Thinn Skin	D	2.05	4.74	1.92	2.10	Very Less
Kurvi-2EL-24685	D	2.12	3.41	2.47	2.24	Less
Speen danedar	D	2.28	3.85	2.55	2.31	Medium
Basein Seedless	D	2.22	3.91	2.20	2.21	Less
Kazaki Anar	D	2.21	3.66	2.47	2.50	Medium
Khog	D	2.70	3.30	2.72	2.30	Medium
A K Anar	D	2.20	3.51	2.90	3.10	Medium
Bocheka Lines	D	2.30	4.96	2.20	2.56	Medium
Gul e Shah	D	2.16	3.81	2.28	2.47	Medium
Sirin Anar	D	2.13	4.10	2.05	1.98	Medium
Dorsetta Malus	D	2.38	4.17	2.40	2.30	Medium
Tabest	D	2.65	3.11	2.04	2.31	More
Kali Sirin	D	2.02	2.81	1.88	1.54	Less
Tujetis EC-104347	D	2.59	3.96	2.18	2.49	Less
CD at 5%		0.45	0.36	0.21	0.27	

EG: Ever Green; D: Deciduous

Results and Discussion

Under arid conditions of Bikaner, Rajasthan, Indian cultivars namely Jalore Seedless, Ganesh, Bedana Suri, P-26, Mridula, G-137, Jodhpur Red, Kabul, GKVKI, Dholka, Coimbatore White, P-23, Yarcuad, Muskat, Patna-5, Jyoti showed ever green nature of growth, while, Bedana Thin Skin, Kurvi-2EL-24685, Speen Danedar, Basein Seedless, Kazaki Anar, Khog, AK Anar, Bocheka Lines, Gul-e-Shah, Sirin Anar, Dorsetta Malus, Tabest, Kali Sirin, Tujetis EC-104347 showed deciduous nature of growth Table 1. The growth analysis shown in Table 1 is the result of measurements taken from 7-year-old plants. Highest plant height (2.70 m) was recorded in cultivar Khog, where as, minimum (1.70 m) was recorded in Bedana Suri while the average for the germplasm was 2.29 m. This value is near the mean height recommended for pomegranate trees (2.50 cm). Bunker and Prasad (1992) also reported differences in vegetative growth of pomegranate varieties grown in different agro climatic zones. Larger height trees hinder the harvest, pest disease control and in many cases are responsible for an insignificant percentile of losses.

For the various characteristics, stem diameter/girth a variation from 2.81 cm in Kali Sirin to 5.45 cm in Jyoti was observed with an average of 3.97 cm. More stern and robust stems better support the main branches and increase sap circulation for the canopy. The cultivar AK Anar had the largest canopy (2.90 cm across row and 3.1 cm along row) while least spread (1.88 cm across row and 1.54 cm along row) was recorded in Kali Sirin. The mean average of all the pomegranate trees in this collection was 2.34 cm along row and 3.97 cm across row. Tree growth habit is determined by various factors like genetic behaviour of tree/genotype, nutritional status of the soil and other management practices as well. Canopies and spread needs to be maintained at a diameter that allows management practices without affecting the growth and development of neighbouring plant. The size of the canopies of the plants examined was acceptable for the space that was available. These values shows that after 7 years of cultivation the pomegranate germplasm had adapted well to the climate and soil, conditions of arid ecosystem and showed good growth characteristics.

Table 2. Leaf and thorn characteristics of pomegranate germplasm

Genotype	Leaf base	Leaf shape	Leaf tip	Leaf length (cm)	Leaf width (cm)	Length of thorn (cm)	Length of thorn (cm)
Jalore Seedless	Cunnate	Elliptic Entire	Cuspidate	4.8	1.8	5.9	5.9
Ganesh	Cunnate	Elliptic Entire	Obtuse	6.4	2.1	6.0	6.0
Bedana Suri	Connate	Elliptic Entire	Obtuse	5.4	2.0	4.0	4.0
P-26	Cunnate	Elliptic Entire	Mucronate	5.2	1.9	4.9	4.9
Mridula	Cunnate	Elliptic Entire	Mucronate	6.0	1.8	7.6	7.6
G-137	Cunnate	Elliptic Entire	Mucronate	6.6	2.0	7.8	7.8
Jodhpur Red	Cunnate	Elliptic Entire	Acute	4.8	2.0	5.4	5.4
Kabul	Cunnate	Elliptic Entire	Acute	5.8	1.7	3.6	3.6
GKVK 1	Cunnate	Elliptic Entire	Obtuse	5.8	2.2	5.5	5.5
Dholka	Cunnate	Elliptic Entire	Acute	6.4	2.2	6.8	6.8
Cimbatore White	Cunnate	Elliptic Entire	Obtuse	5.8	2.0	5.6	5.6
P-23	Cunnate	Elliptic Entire	Mucronate	5.7	2.2	5.8	5.8
Yarcuad	Cunnate	Elliptic Entire	Cuspidate	5.9	2.5	4.4	4.4
Muskat	Cunnate	Elliptic Entire	Acute	5.6	2.0	6.4	6.4
Patna-5	Cunnate	Elliptic Entire	Acute	6.5	2.0	5.2	5.2
Jyoti	Cunnate	Elliptic Entire	Obtuse	4.7	1.8	5.5	5.5
Bedana Thin Skin	Cunnate	Elliptic Entire	Obtuse	5.4	2.0	5.5	5.5
Kurvi-2EL-24685	Cunnate	Elliptic Entire	Cuspidate	8.2	2.7	6.0	6.0
Speen danedar	Cunnate	Elliptic Entire	Acute	5.5	1.7	4.4	4.4
Basein Seedless	Cunnate	Elliptic Entire	Obtuse	4.2	1.8	6.8	6.8
Kazaki Anar	Connate	Elliptic Entire	Acute	5.5	2.0	4.9	4.9
Khog	Cunnate	Elliptic Entire	Acute	5.4	2.2	4.8	4.8
A K Anar	Cunnate	Elliptic Entire	Acute	6.0	2.1	3.9	3.9
Bocheka Lines	Cunnate	Elliptic Entire	Mucronate	5.4	2.3	5.0	5.0
Gul e Shah	Cunnate	Elliptic Entire	Acute	5.5	1.7	3.7	3.7
Sirin Anar	Cunnate	Elliptic Entire	Acute cuneate	4.8	1.9	4.3	4.3
Dorsetta Malus	Cunnate	Elliptic Entire	Obtuse	4.8	1.8	4.2	4.2
Tabest	Cunnate	Elliptic Entire	Acute	5.7	1.9	5.0	5.0
Kali Sirin	Cunnate	Elliptic Entire	Obtuse	5.7	1.6	5.0	5.0
Tujetis EC-104347	Cunnate	Elliptic Entire	Obtuse	4.8	1.8	5.1	5.1
CD at 5%				0.23	0.13	0.17	0.24

A lot of variation was recorded in shape and size of leaf Table 2. All the varieties produced leaves having connate leaf base and elliptic entire leaf shape. Cultivar Jalore seedless, Yercuad produced leaf with cuspidate leaf tip. Cultivar Ganesh, Bedana suri, GKVK I, Jyoti, Bedana Thin Skin, Basein Seedless, Dorsetta Malus, Tujetis EC-104347 produced leaf having obtuse leaf tip, P-26, Mridula, P-23, Bocheka Lines produced leaf with Mucronate tips, Jodhpur Red, Kabul, Dholka, Muskat, Patna-5, Speen Danedar, Kazaki Anar, Khog, A.K. Anar, Gul-e-Shah and Tabest produced leaf with acute leaf tip while Sirin Anar produced acute cunate leaf tip. Maximum leaf length (8.2 cm) was recorded in Kurvi-2EL-24685 and minimum length (4.2 cm) in Basein Seedless, whereas, average was recorded as 5.61 cm. Similarly, leaf width was maximum (2.7 cm) in Kurvi-2EL-24685 and minimum (1.6 cm) in Kali Sirin and the average was 1.98 cm. Germplasm was found to have leaf size just close to the average size leaves. Foliage load is responsible for photosynthesis and carbohydrates in turn responsible for flowering and fruiting.

Wide range of variability was recorded in case of length of thorn, ranging from maximum 7.8 cm in G-137 and minimum in 3.6 cm in Kabul. Whereas, it was 5.3 cm for average of all the germplasm tested. Size of thorns is one of the characters which hinders with various farm operations being carried out.

All the varieties under gremplasm produced male flowers Table 3. Fruit set and bearing capacity of a tree depends upon size of the male, female and hermaphrodite flowers. Maximum length male flowers were recorded in Bedana Thin Skin (3.15 cm) and minimum in Mridula (1.70 cm). Whereas average/mean value was 2.38 cm. Maximum width of male fower was in Tabest (1.95 cm) and least in Gul-e-Shah (1.20 cm) and the mean value recorded was 1.34 cm. Except genotype Patna 5, all varieties under germplasm produced female flowers. Maximum length (4.20 cm) was recorded in Basein Seedless and minimum size of 2.71 cm in Bocheka Lines. Where as, maximum breadth of the flowers was recorded in Bedana Suri (1.91 cm) and the least in Tabest (1.21 cm) and the

Table 3. Flowering characteristics of pomegranate germplasm

Genotypes	Size of flowers (cm)					
	Male		Female		Intermediate	
	Length	Breadth	Length	Breadth	Length	Breadth
Jalore Seedless	2.60	1.40	3.90	1.51	2.90	1.43
Ganesh	2.65	1.52	3.607	1.60	3.52	1.51
Bedana Suri	2.18	1.29	3.38	1.91	–	–
P-26 2.80	1.30	3.80	1.62	2.70	1.28	–
Mridula	1.70	1.23	3.47	1.52	2.78	1.42
G-137	2.68	1.32	3.46	1.40	2.62	1.30
Jodhpur Red	2.72	1.37	3.78	1.62	3.02	1.55
Kabul	2.36	1.36	3.52	1.34	–	–
GKVK 1	2.71	1.31	3.41	1.57	2.51	1.52
Dholka	2.81	1.53	3.82	1.69	2.66	1.29
Coimbatore White	2.11	1.36	2.83	1.41	2.21	1.25
P-23	2.50	1.28	3.79	1.59	2.79	1.38
Yarcuad	2.51	1.42	3.77	1.61	2.41	1.41
Muskat	2.70	1.39	3.22	1.34	2.85	1.10
Patna-5	2.92	1.48	–	–	2.53	1.33
BedanaThin Skin	3.15	1.41	4.13	1.36	2.84	1.60
Kurvi-2EL-24685	2.38	1.29	3.58	1.57	2.20	1.26
Speen danedar	2.33	1.31	3.01	1.60	2.31	1.32
Basein Seedless	2.93	1.64	4.20	1.77	2.93	1.55
Kazaki Anar	2.32	1.51	3.32	1.51	–	–
Khog	2.11	1.27	2.87	1.41	2.81	1.47
A K Anar	2.17	1.31	2.80	1.42	2.77	1.52
Bocheka Lines	2.26	1.47	2.71	1.41	–	–
Gul e Shah	1.90	1.20	2.93	1.23	3.08	1.18
Shirin Anar	2.21	1.40	3.33	1.68	2.60	1.86
Dorsetta Malus	2.10	1.18	2.90	1.71	2.71	1.62
Tabest	2.353	1.90	3.33	1.21	–	–
Kali Sirin	2.59	1.49	3.26	1.42	–	–
Tujetis EC-104347	2.71	1.41	3.01	1.71	3.01	1.51
CD at 5%	0.09	0.07	0.27	0.05	0.18	0.06

Table 4. Physical characteristics of fruits of pomegranate germplasm

Genotypes	Fruit skin colour	Fruit length (cm)	Fruit width (cm)	Average Fruit wt. (g)	No. of fruits/tree	No. of arils/fruit	Size of aril (cm)		Rind thickness (cm)	Seed hardness	Fruit cracking (%)
							L	B			
Jalore Seedless	YRT	8.7	7.2	168	55	157	0.9	1.1	0.34	S	15
Ganesh	YRT	8.4	6.7	160	53	123	0.7	0.9	0.45	S	18
Bedana Suri	YRT	7.21	6.7	124	23	104	0.8	1.0	0.60	H	17
P-26	R	7.5	6.9	157	30	138	1.0	1.2	0.32	S	18
Mridula	R	6.8	5.7	95	80	105	1.0	1.0	0.45	VS	24
G-137	R	8.1	7.0	150	60	116	0.8	1.1	0.43	S	21
Jodhpur red	YRT	5.4	6.7	135	130	125	0.7	0.9	0.34	H	70
Kabul	YR	6.5	6.8	153	75	100	0.7	0.9	0.32	VH	10
GKVK 1	YRT	7.7	6.8	153	28	172	0.9	1.2	0.42	VH	18
Dholka	YRT	7.4	7.7	0193	50	113	0.8	1.1	0.31	SH	25
Cimbatore white	YRT	5.2	6.3	112	45	72	0.5	0.6	0.89	H	22
P-23	YRT	8.1	8.2	185	40	142	0.8	0.9	0.35	S	25
Yarcuad	R	5.5	6.0	91	55	167	0.9	1.4	0.45	VH	40
Muskat	YRT	8.5	7.5	188	20	205	0.9	1.2	0.43	VH	16
Patna-5	YRT	6.9	7.2	125	10	298	1.4	0.9	0.48	VH	11
Bedana Thin Skin	YRT	6.0	6.2	100	41	59	0.9	1.1	0.35	SH	25
Kurvi-2EL-24685	L R	5.1	5.7	135	50	89	0.7	0.9	0.45	SH	21
Speen Danedar	YRT	5.0	7.0	146	60	112	0.8	1.0	0.46	VH	31
Basein Seedless	YRT	6.8	6.7	117	40	150	0.8	1.0	0.42	VH	35
Kazaki Anar	YRT	7.5	6.8	75	40	144	0.9	1.1	0.45	S	10
Khog	R	6.1	5.2	108	80	143	0.9	1.2	0.45	SH	33
A K Anar	R	6.1	6.8	112	30	85	0.8	0.9	0.67	H	20
Bocheka Lines	LR	5.9	5.6	90	21	70	0.7	0.9	0.23	VH	16
Gul e Shah	YRT	5.5	5.5	88	30	98	0.7	0.7	0.34	H	12
Sirin Anar	YRT	5.8	6.1	100	140	103	1.3	1.1	0.34	VH	31
Dorsetta Malus	R	5.5	5.8	196	10	157	0.6	0.8	0.40	VH	15
Tabest	YRT	6.8	7.0	106	126	142	1.0	1.2	0.45	SH	33
Kali Sirin	YRT	5.6	5.8	102	60	112	0.8	0.8	0.34	VH	25
Tujetis EC-104347	R	5.5	5.1	143	10	115	0.9	1.1	0.36	VH	26
CD at 5%		1.04	0.90	10.09	6.00	15.09	0.06	0.04	0.08		2.57

YRT = Yellow Red Tinge; R = Red; YR = Yellow Red; LT = Light Red

S = Soft; H = Hard; VS = Very Soft; VH = Very Hard; SH = Semi Hard

mean value was 1.47 cm. Martinez *et al.* (2000) also observed that heterosity in terms of flower characteristics is a common occurrence in different clones of pomegranate.

Except Bedana Suri, Kabul, Kazaki Anar, Bocheka Lines, Tabest, Kali Sirin, all the cultivars in germplasm produced hermaphrodite flowers. There was wide range of diversity in case of the size of Hermaphrodite flowers. Maximum size (3.52 cm) was recorded in Ganesh and least length (2.20 cm) in Kurvi-2EL-24685, where as, mean value recorded was 2.61 cm. Maximum breadth of hermaphrodite flowers was 1.86 cm found in Sirin Anar and minimum breadth 1.10 cm in Muskat and mean value was 1.36 cm.

With regard to fruit shape wide range was observed. In cultivars GKVK, Speen Danedar, Bocheka Lines, Doretta Malus and Tujetis EC-104347 fruits were flat round whereas, rest of varieties produced round fruits. Similarly, there was lot of difference and variation in fruit skin colour, which ranges from red (P-26, Mridula, G-137, Khog,

Yarcuad, AK Anar, Dorsetta Malus, Tujetis EC-104347) to yellowish red ting (Jalore Seedless, Ganesh, Bedana suri, Jodhpur red, GKVK-1, Dholka, Coimbatore White, P-26, Muskat, Patna-5, Bedana Thin Skin, Speen Danedar, Basein Seedless, Kazaki Anar, Gul-e-Shah, Sirin anar, Tabest, Kali sirin) and light red (Kurvi-2EL-24685 and Bocheka Lines).

Table 4 shows the physical characteristics of the fruits. With regard to length of fruit it was maximum (8.7 cm) in Jalore Seedless and minimum in Speen Danedar (5.0 cm), whereas, mean value was 6.50 cm in. Similarly maximum fruit width was 7.7 cm recorded for Dholka and mean value was 6.51 cm.

Average fruit weight was maximum (196.0 g) in Dorsetta Malus and minimum (75.0 g) in Kazaki Anar while its mean value was 131.13 g.

Owing to great incidence of fruit cracking, day night fluctuation of temperature, hot summer and cold winter, it was necessary to select promising genotypes for producing

healthy and sound fruits. Number of fruits/tree ranged from 130 in Jodhpur red to minimum of 10.0 in Patna-5 and Dorsetta Malus while mean value was 48.48.

There was quite a wide range of variability in number of arils/fruit, which ranged from 298 in Patna-5 to 70.0 in Bocheka Lines and mean value was 128.20.

Maximum length of aril was recorded in Patna-5 (1.4 cm) and minimum (0.5 cm) in Coimbatore White, and the average value was 0.84 cm. Maximum breadth (1.4 cm) of aril was recorded in Yercaud and minimum (0.6 cm) in Coimbatore White, whereas, mean value was 1.09. Maximum thickness of the rind (0.89 cm) was recorded in Coimbatore White and minimum (0.23 cm) in in Bocheka Lines.

There was difference in seed hardness among various cultivars varying from very soft (Mridula), soft (Jalore Seedless, P-26, G-137, P-23, Kazaki Anar), Semi Hard (Dholka, Bedana Thin Skin, Kurvi-2 EL-24685, Khog, Tabest), Hard (Bedana suri, Jodhpur Red, Coimbatore White, AK Anar, Gul-e-Shah) and Very Hard (Kabul, GKVK-I, Yarcuad, Muskat, Patna-5, Speen Danedar, Basein Seedless, Bocheka Lines, Dorsetta Malus, Kali Sirin, Tujetis EC-104347).

Maximum cracking (70%) was found in Jodhpur Red and minimum in Kabul and Kazaki Anar (10.0%), Patna-5 (11.00) Gul-e-Shah (12.0%), Dorsetta Malus and Jalore Seedless (15.0%). Singh (2007) and Mali and Prasad (1999) also reported similar cracking in Jodhpur Red genotype 1. Cracking may be attributed to weather conditions, particularly prevalence of high temperature and moisture stress condition of the soil (Singh *et al.*, 2003). A positive correlation of primary nutrients (leaf and fruit), leaf gas exchange properties, leaf water potential and other fruit characteristics with the ration and tendency of cracking was found by Hepaksoy *et al.* (2000).

A lot of variation was found in case of colour of arils; varying from White (Patna-5), Light Pink (Bedana Suri, P-26, G-137, Kabul, GKVK-I, Dholka, Coimbatore White, P-23, Muskat, Bedana Thin Skin, Kazaki Anar, Khog, Ak Anar, Pink (Jalore Seedless, Ganesh), Red (Yercuad, Kurvi-2EL-24685, Bocheka Lines, Gul-e-Shah, Tujetis EC-10437) and Blood Red (Mridula, Jodhpur Red, Sirin Anar, Tabest, Kali Sirin) (Table 5).

Quality of fruits and adaptability to climate decides the selection of particular variety or genotype. Juice recovery is the character which determines processing potential of cultivar/genotype. Enormous variation was

Table 5. Chemical composition of fruits of pomegranate genotypes.

Genotypes	Aril colour	Juice (%)	TSS (% B)	Acidity (%)
Jalore Seedless	Pink	51	18.5	0.76
Ganesh	Pink	50	18.0	0.76
Bedana Suri	Light pink	36	18.5	0.80
P-26	Light pink	51	19.0	0.72
Mridula	Blood red	52	18.0	0.76
G-137	Light pink	49	17.0	0.70
Jodhpur Red	Light red	49	15.6	0.70
Kabul	Light pink	42	18.0	0.72
GKVK 1	Light pink	43	18.5	0.72
Dholka	Light pink	50	19.0	0.70
Coimbatore White	Light pink	49	18.0	0.83
P-23	Light pink	51	18.5	0.73
Yarcuad	Red	49	17.5	1.50
Muskat	Light pinkp	43	19.0	0.78
Patna-5	White	40	20.0	1.00
Bedana Thin Skin	Light pink	42	17.0	0.68
Kurvi-2EL-24685	Red	43	19.5	1.08
Speen Danedar	Light pink	40	20.5	0.89
Basein Seedless	Light pink	45	17.5	1.08
Kazaki Anar	Light pink	48	17.5	1.21
Khog	Light pink	41	18.0	2.30
A K Anar	Light pink	45	21.0	0.83
Bocheka Lines	Red	43	19.5	1.50
Gul e Shah	Red	41	18.5	1.98
Sirin Anar	Blood red	47	18.0	2.30
Dorsetta Malus	Red	41	19.0	3.41
Tabest	Blood red	47	19.5	1.98
Kali Sirin	Blood red	36	17.5	2.88
TujetisEC-104347	Red	44	16.5	3.70
CD at 5%		4.08	0.79	0.07

observed in juice content of the fruits. Maximum juice percentage (52.0%) was recorded in Mridula followed by Jalore Seedless (51.0%), P-26 (51.0%) and least (36.0%) in Kali Sirin, whereas, average was 45.10%. The results are in line with the findings of Malhotra *et al.* (1983), Mali and Prasad (1999), and Singh (2004). With regards to TSS of fruits in pomegranate presented enormous variability was recorded. Fruits with high TSS and less acidity can be consumed raw as well as processed, while fruits with high acidity can be exploited for making dehydrated arils (anardana) and acidulant used for culinary and confectionary purpose (Singh *et al.*, 2007). Maximum TSS (21.0°B) was recorded in AK Anar, Speen Danedar (20.5°B) and least in Jodhpur Red (15.6°B), whereas, average value for TSS was 18.3°B. Acidity was recorded in the range of maximum (3.70%) Tujetis EC-104347, Dorsetta Malus (3.41%), Sirin Anar (2.30%), Kali Sirin (2.88%), whereas, minimum was recorded in Bedana Thin Skin (0.68%). Mali and Prasad (1999) reported good performance of variety Jalore Seedless, Ganesh and G-137 under arid climate while Godhara *et al.* (1989) reported that Chawla and Nabha varieties are suitable under Hissar

conditions and Umrao *et al.* (1995) reported that Dholka and Ganesh performed better in north Indian conditions. This detailed study and information on genetic variability and evaluation of pomegranate germplasm under arid ecosystem will ensure and confirm the suitability of some promising pomegranate genotype. Long term conservation of these genotypes will provide the genetic stock for commercial exploitation and doing research for further improvement of varieties.

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