



Characterization of pomegranate varieties based on DUS descriptors

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ABSTARCT

Registering commercial and extant pomegranate varieties is a pre-requisite for protection of the rights of breeders and farmers under the IPR regime. Characterization of 12 pomegranate varieties was done with respect to distinctiveness; uniformity and stability (DUS) test guidelines. Characterization of pomegranate varieties showed wide variation with respect to 36 essential characters (33 morphological and 3 biochemical) identified in DUS descriptors. The results suggest that description of these varieties based on notes and states may be used as reference for protection of new varieties under PPV&FRA Rules, 2001. The database generated may be useful for comparison against the candidate varieties developed in future.

Key words: Characterization, diversity analysis, pomegranate, DUS descriptors.

INTRODUCTION

Pomegranate (*Punica granatum* L.) belonging to family Punicaceae is an economically important fruit crop of arid and semi-arid regions of the world. It is a good source of protein, carbohydrate, minerals, antioxidants, vitamins A, B and C. In India also, it is an important fruit crop for arid and semi-arid regions. Maharashtra is the leading state in India followed by Karnataka, Andhra Pradesh, Gujarat and Rajasthan with respect to area and production of pomegranate (Ram Chandra *et al.*, 8).

With signing of TRIPS agreement of the WTO, India has agreed to provide protection to plant varieties including fruit crops. In this context, Protection of Plant Varieties and Farmers Right Authority (PPV&FRA), New Delhi has a Distinctness Uniformity and Stability (DUS) test procedure and national DUS test guidelines for all the fruit crops. The test guidelines for conducting DUS test on pomegranate have been developed by task force committee constituted by the PPV & FRA Authority, New Delhi in consultation with nodal and co-nodal centers. The task force committee has finalized 36 essential test characters in their test guidelines. Morphological characterization of pomegranate varieties was carried out with respect to distinctiveness; uniformity and stability (DUS) test guidelines. These tested varieties may be used as reference for comparison against the candidate varieties developed in future. This will enable PPV & FRA, New Delhi to register and issue necessary certificate under PPV&FRA Rules, 2001 to researcher or farmers. This investigation may

also be helpful to the researchers with respect to improvement of pomegranate varieties for particular traits in arid regions.

MATERIALS AND METHODS

Twelve popular varieties, *viz.*, Mridula, Sinduri, Ganesh, Phule Arakta, G 137, P-23, P-26, Jalore Seedless, Dholka, Basein Seedless, Jodhpur Red and CAZRI Selection were evaluated at field gene bank of ICAR-CAZRI, Jodhpur, Rajasthan for three consequent years (2012-14) in a randomized block design with three replications as per PPV&FRA, DUS test guidelines. Plants were planted at 5 m × 4 m apart and maintained under uniform cultural practices and drip system of irrigation as recommended by Prasad *et al.* (7). Two plants of uniform size and vigour from each replications were selected for recording observations. Varieties were evaluated for 36 descriptors, *viz.*, Bush/ tree height (m), bush/ tree growth habit, precocity (year after planting), shoot thorniness (number of thorns per metre shoot length), bush/tree foliage density, leaf blade length (cm), leaf blade width (cm), leaf blade shape, leaf apex shape, petiole length (mm), petiole anthocyanin colouration (% part covered), calyx length (mm), calyx width (mm), calyx colour, corolla colour, corolla type, petal length (mm), petal width (mm), fruit length (cm), fruit diameter (cm), fruit shape, fruit colour, rind thickness (mm), nipple or fin, crown length (mm), crown neck, aril colour, aril length (mm), aril width (mm), seed hardness, seed length (mm), seed width (mm), fruit maturity (days after anthesis), total soluble solids (TSS) (%), acidity (%), and fruit juiciness (%). Crop was retained for *Mrig bahar* flowering in July-August and fruiting in December-March. Observations were

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recorded on two trees in each replication from all side of trees at specified stage of crop growth period. All the 36 characters were observed according to DUS descriptors.

RESULTS AND DISCUSSION

The characterization of pomegranate varieties based on DUS descriptors are presented in Table 1. Considerable variation was observed for most of the DUS characters among the 12 varieties studied. Among the varieties, nine were grouped having medium tree height; two, viz. Jalore Seedless and Jodhpur Red showed tall and CAZRI Selection had small tree height. All the varieties were evergreen except Basein Seedless and grouped under spreading growth habit except Mridula, which has upright and Basein Seedless as drooping growth habit. On the basis of precocity, pomegranate varieties could be grouped into three categories, viz. early, medium and late. Sinduri showed early fruiting whereas, P-23, P-26 and Dholka categorized as late in fruiting while remaining eight varieties were put in medium category. Number of thorns per metre shoot length was recorded higher in varieties Phule Arakta, P-23, Dholka, Jodhpur Red and CAZRI Selection, whereas, shoot thorniness in other seven varieties were in medium range. Among the 12 varieties two showed sparse foliage density (Mridula, Basein Seedless), four varieties showed dense foliage (viz. G 137, P-23, Jalore Seedless, Dholka) and remaining six varieties (viz. Sinduri, Ganesh, Phule Arakta, P-26, Jodhpur Red and CAZRI Selection) showed medium foliage density. The leaf blade length of mature leaves from middle portion of shoots was found large for six varieties and medium for other six varieties, however, width of leaf blade at centre of the leaves was medium in size for all varieties except Dholka, which had broader leaf blade. Based on leaf blade shape pomegranate varieties were grouped in two categories, viz. four varieties, namely, Ganesh, Phule Arakta, P-23, and CAZRI Selection showed elliptical lanceolate and Mridula, Sinduri, G 137, P-26, Jalore Seedless, Dholka, Basein Seedless and Jodhpur Red showed lanceolate shape of leaf blade. Similarly, six varieties, viz., Mridula, Phule Arakta, G 137, P-26, Jodhpur Red and CAZRI Selection expressed acute leaf apex shape and remaining six varieties, viz. Sinduri, Ganesh, P-23, Jalore Seedless, Dholka and Basein Seedless showed obtuse leaf apex shape. Petiole length of all the varieties was found in medium range. Petiole anthocyanin coloration was expressed low in four varieties, while eight varieties had medium levels. Flower calyx length of all the varieties was found in medium range, whereas, calyx width was recorded

broad in G137 and Dholka and remaining eight varieties showed medium calyx width. Red colour of calyx was found in five varieties, viz. Mridula, Phule Arakta, Sinduri, Basein Seedless, CAZRI Selection and rest 7 varieties had orange coloured calyx. Six varieties, viz. Mridula, Phule Arakta, Sinduri, G 137, P-23, and CAZRI Selection showed red colour of corolla and rest six varieties showed orange colour however none of the varieties showed white or yellow colour of corolla. Mridula and Phule Arakta had double corolla type, while rest 10 varieties have single type of corolla. Three varieties, i.e. Sinduri, Dholka, Basein Seedless have long flower petals and rest 9 varieties had medium petal length however, petal, width was recorded broad in cvs. Phule Arakta, P-26, Dholka, Basein Seedless and CAZRI Selection and remaining varieties expressed medium petal width. Four varieties, i.e. Mridula, Sinduri, Dholka, Basein Seedless had short, while and five varieties, viz. Phule Arakta, G 137, P-23, P-26, and CAZRI Selection expressed medium, while three varieties Ganesh, Jalore Seedless and Jodhpur Red had long fruit. However, 8 varieties showed medium fruit diameter and 3 varieties, viz. Ganesh, G137 and Jodhpur Red have large and only one varieties, i.e. Mridula have small fruit diameter. As far as fruit shape is concerned, six varieties were round in shape; four ovate shape and G137 and Jalore Seedless had oval shape fruits. Varieties Mridula and Sinduri had deep red colour fruit, while Phule Arakta, G 137, and CAZRI Selection showed red colour fruit and rest seven varieties were yellowish-red or reddish-yellow and none of varieties expressed pure yellow or red therefore grouped under other category. Rind thickness of all the varieties assemblage under medium category. Nipple or fin on fruit was present in 9 varieties, while it was absent in four varieties, viz., Mridula, G 137, P-23 and Jodhpur Red. Three varieties, viz. G 137, Dholka and Jodhpur Red expressed short crown and rest 8 varieties showed medium crown length, while, it was absent in cultivar Base in Seedless. On the basis of aril colour, the varieties could be grouped into four categories, viz. deep red (Mridula); red (Sinduri and Phule Arakta) and light pink (Dholka), while rest eight varieties showed pink colour aril. None of varieties expressed white or light yellow aril colour. Aril length was short in 9 varieties and medium in three varieties, whereas, broad aril was found in four varieties, viz. Ganesh, Phule Arakta, G137 and Jalore Seedless, while in rest 8 varieties aril width was found medium. Three varieties, i.e. Jalore Seedless, Sinduri and CAZRI Selection have soft seed, while six varieties have medium soft seed and three varieties, viz., P-26, Dholka and Jodhpur Red had seed.

Table 1. Narration of pomegranate varieties based on notes of essential DUS characters.

Variety	DUS traits											
	1	2	3	4	5	6	7	8	9	10	11	12
Miridula	5	3	5	5	3	7	5	5	3	5	5	5
Sinduri	5	5	3	5	5	7	5	5	5	5	5	5
Ganesh	5	5	5	5	5	5	5	3	5	5	3	5
Phule Arakta	5	5	5	9	5	7	5	3	3	5	5	5
G 137	5	5	5	5	7	7	5	5	3	5	3	5
P-23	5	3	5	9	7	5	5	3	5	5	3	5
P-26	5	5	7	5	5	5	5	5	3	5	3	5
Jalore Seedless	7	5	5	5	7	5	5	5	5	5	5	5
Dholka	5	5	5	9	7	7	7	5	5	5	5	5
Basein Seedless	5	7	5	5	3	7	5	5	5	5	5	5
Jodhpur Red	7	5	5	9	5	5	5	5	3	5	5	5
CAZRI Selection	3	5	5	9	5	5	5	3	3	5	5	5
State	3. Sall (<1.5) 5. Mediu (1.5-2.5) 7. High (>5)	3. Upright 5. Spreading 7. Drooping	3. Early (<2) 5. Medium (2-3) 7. Late (>3)	1. Absent 2., 3. Less (<5) 5. Medium (5-10) 9. High (>10)	3. Sparse 5. Medium 7. Dense	3. Short (<2) 5. Medium (2-5) 7. High (>5)	3. Narrow (<1) 5. Medium (1-2) 7. Broad (>2)	3. Elliptic lanceolate 5. Lanceolate 7. Broad elliptic	3. Acute 5. Obtuse 7. Round	3. Short (<4) 5. Medium (4-6) 7. Long (>6)	3. Low (<25) 5. Medium (25-50) 7. High (>50)	3. Short (<20) 5. Medium (20-40) 7. Long (>40)
Variety	13	14	15	16	17	18	19	20	21	22	23	24
Miridula	5	7	7	9	5	5	3	3	1	7	5	1
Sinduri	5	7	7	1	7	5	3	5	1	7	5	9
Ganesh	5	5	5	1	5	5	7	7	3	9	5	9
Phule Arakta	5	7	7	9	5	7	5	5	5	5	5	9
G 137	7	5	7	1	5	5	5	7	1	5	5	1
P-23	5	5	7	1	5	5	5	5	3	9	5	1
P-26	5	5	5	1	5	7	5	5	1	9	5	9
Jalore Seedless	5	5	5	1	5	5	7	5	5	9	5	9
Dholka	7	5	5	1	7	7	3	5	3	9	5	9
Basein Seedless	5	7	5	1	7	7	3	5	3	9	5	9
Jodhpur Red	5	5	5	1	5	5	7	7	1	9	5	1
CAZRI Selection	5	7	7	1	5	7	5	5	1	5	5	9

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State	25	26	27	28	29	30	31	32	33	34	35	36																											
State	3. Short (<15)	5. Medium (15-25)	7. Long (>25)	3. Narrow (<10)	5. Medium (10-20)	7. Broad (>20)	3. Short (<6.0)	5. Medium (6.0-8.0)	7. Long (>8.0)	3. Small (<5.0)	5. Medium (5.0-7.0)	7. Large (>7.0)	1. Round (1.0-1.1)	3. Ovate (1.1-1.2)	5. Oval (1.2-1.3)	7. Elliptical (>1.3)	3. Yellow	5. Red	7. Deep Red	9. Others	3. Thin (<3.0)	5. Medium (3-5)	7. Thick (>5.0)	1. Absent															
Variety	3. Short (<15)	5. Medium (15-25)	7. Long (>25)	3. Narrow (<10)	5. Medium (10-20)	7. Broad (>20)	3. Short (<6.0)	5. Medium (6.0-8.0)	7. Long (>8.0)	3. Small (<5.0)	5. Medium (5.0-7.0)	7. Large (>7.0)	1. Round (1.0-1.1)	3. Ovate (1.1-1.2)	5. Oval (1.2-1.3)	7. Elliptical (>1.3)	3. Yellow	5. Red	7. Deep Red	9. Others	3. Thin (<3.0)	5. Medium (3-5)	7. Thick (>5.0)	1. Absent															
Mridula	5	9	8	3	5	5	5	5	5	5	5	5	5	5	5	5	5	7	7	7	7	3	3	7															
Sinduri	5	9	7	5	5	3	3	3	3	3	3	3	3	3	3	3	3	7	7	7	7	5	5	5															
Ganesh	5	9	5	3	5	3	5	5	5	5	5	5	5	5	5	5	5	7	7	7	7	5	5	5															
Phule Arakta	5	9	7	3	5	5	3	3	3	3	3	3	3	3	3	3	3	7	7	7	7	5	5	5															
G 137	3	9	5	3	5	5	5	5	5	5	5	5	5	5	5	5	5	7	7	7	7	5	5	5															
P-23	5	9	5	3	5	5	3	3	3	3	3	3	3	3	3	3	3	7	7	7	7	5	5	5															
P-26	5	9	5	5	5	7	3	3	3	3	3	3	3	3	3	3	3	5	5	5	5	5	5	3															
Jalore Seedless	5	9	5	5	5	3	5	3	3	3	3	3	3	3	3	3	3	7	7	7	7	5	5	7															
Dholka	3	9	3	3	5	7	5	3	3	3	3	3	3	3	3	3	3	5	5	5	5	5	5	3															
Basain Seedless	3	1	5	3	5	3	5	3	3	3	3	3	3	3	3	3	3	7	7	7	7	3	3	5															
Jodhpur Red	3	9	5	3	5	7	5	3	3	3	3	3	3	3	3	3	3	5	5	5	5	5	5	3															
CAZRI Selection	5	9	5	3	5	3	5	3	3	3	3	3	3	3	3	3	3	7	7	7	7	3	3	5															
State	3. Short (<15)	5. Medium (15-25)	7. Long (>25)	1. Absent	9. Present	1. White	2. Light Yellow	3. Light Pink	5. Pink	7. Red	8. Dark Red	9. Others	3. Short (<10)	5. Medium (10-15)	7. Long (>15)	3. Narrow (<5)	5. Medium (5-7.5)	7. Broad (>7.5)	3. Soft	5. Medium	7. Hard	3. Short (<6.0)	5. Medium (6-10)	7. Long (>10)	3. Narrow (<2.5)	5. Medium (2.5-5.0)	7. Broad (>5.0)	3. Early (<130)	5. Medium (130-175)	7. Late (>175)	3. Low (<12.5)	5. Medium (12.5-16)	7. High (>16.0)	3. Low (<0.5)	5. Medium (0.5-2.5)	7. High (>1.25)	3. Low (<50)	5. Medium (50-60)	7. High (>60)

1. Bush/tree height (m), 2. Bush/tree growth habit, 3. Precocity (year after planting), 4. Shoot thorniness (No. of thorns per metre shoot length), 5. Bush/tree foliage density, 6. Leaf blade length (cm), 7. Leaf blade width (cm), 8. Leaf blade shape, 9. Leaf apex shape, 10. Petiole length (mm), 11. Petiole anthocyanin colouration (% part covered), 12. Calyx length (mm), 13. Calyx width (mm), 14. Calyx colour, 15. Corolla colour, 16. Corolla type, 17. Petal length (mm), 18. Petal width (mm), 19. Fruit length (cm), 20. Fruit diameter (cm), 21. Fruit shape, 22. Fruit colour, 23. Rind thickness (mm), 24. Nipple or fin, 25. Crown length (mm), 26. Crown neck, 27. Aril colour, 28. Aril length (mm), 29. Aril width (mm), 30. Seed hardness (PSI), 31. Seed length (mm), 32. Seed width (mm), 33. Fruit maturity (days after anthesis), 34. Total soluble solids (TSS) (%), 35. Acidity (%), and 36. Fruit juiciness (%).

Length of seed was short in four varieties, viz. Sinduri, Phule Arakta, P-23 and P-26, while rest 8 varieties were categorized in medium seed length whereas, seed width was found narrow in 8 varieties and medium in four varieties, viz., Mridula, Ganesh, G 137 and P-26. Based on fruit maturity after anthesis all the varieties were grouped in medium maturity period except Mridula, CAZRI Selection and Phule Arakta, which, were early in maturity. Total soluble solid contents of 9 varieties were found high and three, viz. Jodhpur Red, Dholka and P-26 medium and none of varieties were under low TSS content category. Three varieties, namely, Mridula, Basein Seedless, and CAZRI Selection had low acidity in juice, while rest 9 varieties had medium content. On the basis of fruit juice content, pomegranate varieties could be grouped into three categories, i.e. medium in seven varieties, low three varieties, i.e. P-26, Dholka, and Jodhpur Red and only two varieties, i.e. Mridula and Jalore Seedless showed high per centage of fruit juice. Characterization of pomegranate varieties in present study showed wide variation with respect to 36 essential characters identifies as DUS description, which would help in the quantification and organization of genetic diversity in future breeding programme. The results of present study is in accordance with the Meena *et al.* (3), Mir *et al.* (5) and Singh *et al.* (9). Diverse variability with respect to growth yield and other morphological characters in pomegranate varieties under different climatic conditions were also described by Singh, (10), Prasad and Bankar (6), Mir *et al.* (4), Kumar and Khosla (1) and Meena *et al.* (2).

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