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Performance of pomegranate (*Punica granatum*) cultivars under semi-arid condition of Haryana

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Abstract

The experiment was conducted at Department of Horticulture, CCS HAU, Hisar, to evaluate the growth performance of ten different pomegranates germplasm, viz Mridula, Bhagwa, Kandhari, Ganesh, Jodhpur Red, Jalore Seedless, Basein Seedless, Wonderful, S1 and S2 in semi-arid condition of Haryana, during 2018-19. Data revealed that maximum plant height (3.39 m) was observed in cv. Bhagwa and minimum (2.34) in S1. Plant spread was recorded maximum in cv. Bhagwa in the both direction (3.15 m E-W and 3.05 m N-S) and minimum in Mridula (2.05 m) in E-W direction and S1 (2.01m) in N-S direction. Majority of pomegranate varieties had spreading type of growth habit except Mridula and Bhagwa which had drooping type. Number of thorns was maximum (29) in Mridula and minimum (21) in Basein Seedless. Maximum leaf blade length and width was recorded in Mridula (8.30 cm and 2.82 cm) and minimum in Bhagwa (4.82 cm and 1.65 cm). Mridula, Bhagwa, Basein Seedless, Kandhari, Wonderful, S1 and S2 had lanceolate type of leaf blade shape, whereas Jodhpur Red, Ganesh and Jalore Seedless had broad elliptic type. Leaf petiole length was observed maximum (9 mm) in Kandhari and minimum (5.66 mm) in Jodhpur Red.

Key words: Growth, Plant height, Petiole, Semi-Arid, Tropical, Subtropical, Rain fed

Pomegranate (*Punica granatum* L.) is one of the important fruit crops of tropical and subtropical regions of family Punicaceae (Sarkhosh *et al.*, 2025). A native fruit of Iran (Nemati *et al.*, 2012), it is grown in India, Baluchistan, China, Japan, USA and Afghanistan (Sarkhosh *et al.*, 2009). In India, it grows in about 2.7 lakh ha and producing 30.86 lakh tonnes (Government of India 2023). The tree can thrive well in wide range of soil types and climate, but it requires long, hot and dry season to produce better yields (Holland *et al.*, 2009). The crop is drought tolerant and winter hardy (Soloklui *et al.*, 2012) and can be effectively grown even under the purely rain fed condition. It can also tolerate moderate saline, calcareous and slightly alkali soils. Pomegranate cultivation has quickly expanded because of its superior adaptability, resistance to diverse stresses, high remuneration value and multipurpose nature of the fruit (Solanki *et al.*, 2023). However, for its commercially utilization, the evaluation of genotype is the area of major concern. The semi-arid conditions of Haryana proved to be partially suitable for its cultivation, consequently it can be considered as a potential fruit for Haryana state. Hence an experiment was conducted to study the adaptability of its different varieties on the basis of growth performance of different germplasm.

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MATERIALS AND METHODS

The experiment was conducted out at Department of Horticulture, CCS HAU, Hisar, during 2018-19. The experiment site is positioned at an elevation of 215.2 m above sea-level, marked by coordinates of 29° 10" N latitude and 75° 46" E longitudes. Hisar has semi-arid climate characterized by hot and dry summer and exceedingly frigid winter. It receives annual rainfall of about 450 mm, mostly during the month of July - September, and also receive some drizzling during December to February due to western disturbances. Evaluation of 10 pomegranate germplasm (Mridula, Bhagwa, Kandhari, Ganesh, Jodhpur Red, Jalore Seedless, Basein Seedless, Wonderful, S1 and S2) was carried out in a randomized block design with three replications. For research work, seven years old uniformly grown trees were randomly selected and kept under uniform condition of orchard management where every facet of orchard management adhered rigorously to the prescribed package of practices. Different vegetative parameters were recorded at appropriate growth stages, following the guidelines outlined in the NBPGR descriptor as well as directives for DUS testing of Plant Protection Variety and Farmers Rights (PPV&FRA, 2016).

For measuring bush/tree height (m) three individual bush/tree of each germplasm randomly selected and were marked as replications in the field. The height was gauged using graduated measuring pole from ground level to the tip of the highest shoot. Plant spread (m) was assessed in both directions, i.e. from north to south and east to

west with the help of the graduated measuring bar. The growth habit of tree was noticed and recorded as per its visual appearance and expressed as upright/spreading/drooping. The number of thorns/m of shoot length was counted and interpreted as per the guidelines of DUS testing of PPV and FRA (PPV&FRA, 2016). Foliage density of a pomegranate tree was observed in running per meter and elucidated as sparse (less foliage density), medium (the density of foliage lies between dense and sparse) and dense (leaf were observed so close on branches). Five leaves were randomly selected from each side of each tree/replication for leaf blade length (cm) and width (cm) and it was measured using measuring scale.

The average value of replications was calculated. Shape of the leaf blade was visually observed and depicted as elliptic lanceolate (leaves are significantly longer and broader in the middle and the two ends narrow equally), lanceolate (leaves are significantly longer than wide and widest below the middle gradually tapering toward the axis) and broad elliptic (leaves are oval in shape widest from the middle part). Leaf apex shape was observed visually and interpreted as acute (leaf margin tapers to a point at the apex), obtuse (the leaf apex is blunt to rounded and a little pointed) and rounded (leaf apex is totally rounded). For petiole length (mm), from each side of each tree/replication five leaves were randomly selected and measured with the help of measuring scale. The petiole anthocyanins coloration was observed visually and interpreted as per cent part covered as low (<25 %), medium (25-50 %) and high (>50 %) given in the guidelines for DUS testing of PPV and FRA (Anonymous, 2016). The data collected were statistically evaluated using Fishers (1958) analysis of variance (ANOVA) technique. The mean value of different parameters was compared using critical difference. The entire statistical analysis was carried out by statistical software OPSTAT.

RESULTS AND DISCUSSION

The plant height of different pomegranate germplasm varied from 2.34 m to 3.39 m. Maximum plant height was noticed in Bhagwa (3.39 m), which was statistically at par with Jodhpur Red (3.31 m), whereas minimum was in S1 (2.34 m) (Table 1). The difference in plant height might be also due to the individual growth behaviour of genotype (Dubey *et al.*, 2002). These variations may also be attributed to genetic makeup of plant. However, the variations in plant height of the same varieties in a different area may be due to adaptability and performance of varieties with the prevailing local climatic condition. The results are similar to those of Wani *et al.* (2012). Plant spread was recorded maximum in Bhagwa in both directions. Whereas, minimum plant spread was noticed in variety Mridula (2.05 m) in E-W direction and S1 (2.01m) in N-S direction. Meena *et al.* (2011) also reported that minimum plants spread in N-S and E-W direction was observed in Sur Sakkar and Jyoti, whereas, 'Jodhpur Red' exhibited maximum E-W spread and 'Ganesh' maximum N-S spread.

Data on growth habit (Table 1) elucidates that majority of pomegranate varieties, Ganesh, Kandhari, Jodhpur Red, Jalore Seedless, Basein Seedless, Wonderful and, S1 and S2 had spreading type of growth habit, whereas Mridula and Bhagwa had drooping type of growth habit. The differences in growth of varieties might be due to their genetic makeup, prevailing climatic condition and/or the interaction effect of genotype with environment. The cultivars must be selected on the basis of their performance under particular condition because the same variety behaves differently with a change in agroclimatic conditions. The results are in accordance with Sharma *et al,* 2010. Foliage density was observed dense in pomegranate varieties, viz. Mridula, Bhagwa, Ganesh, S1 and S2, whereas it was medium in Kandhari, Jodhpur Red, Jalore Seedless, Basein Seedless and Wonderful.

The difference in foliage density among genotypes might be due to a genetic feature of a particular variety. This type of variation was also noticed by Shalu *et.al* (2017) and Sharma *et.al* (2010) in guava and Mor *et. al* (2022) in Phalsa. Data on number of thorns showed significant variations among different varieties (Table 1). The number of thorns/m of shoot length ranges from 21 to 29. The maximum (29) was reported in variety Mridula which was statistically at par with Ganesh, whereas the minimum (28) number of thorns was observed in variety Basein Seedless (21). The observed differences in numbers of thorn among germplasm under different agroclimatic condition might be due to their genetic makeup. Khanizadeh *et al.* (2016) and Srivastava *et al.* (2023) also observed variations in number of thorns in pomegranate cultivars.

In Mridula, maximum leaf blade length (8.30 cm) was recorded, which was statistically at par with Basein Seedless (7.76 cm). The minimum leaf blade length was recorded in cultivar Bhagwa (4.82 cm). The results are more or less in close conformity with those of Singh (2012). Leaf blade width ranged from 1.65 cm to 2.82 cm. The maximum leaf blade width (2.82 cm) was recorded in variety Mridula which was statistically at par with Jalore Seedless (2.45 cm), Basein Seedless (2.57 cm) and Wonderful (2.56 cm). While, minimum leaf blade width was observed in variety Bhagwa (1.65 cm). Singh (2012) observed maximum leaf width in variety Kurvi-2EL-24685 and minimum in Kali Sirin. Mridula, Bhagwa,

Table 1: Bush/ tree height, spread, growth habit, foliage density and number of thorns of pomegranate varieties under semi-arid condition of Haryana

Variety	Plant height (m)	Plant spread (m) E-W	Plant spread (m) N-S	Growth habit	Foliage density	Number of thorns/m shoot length
Mridula	2.40	2.05	2.02	Drooping	Dense	29
Bhagwa	3.39	3.15	3.05	Drooping	Dense	26
Ganesh	2.65	2.34	2.21	Spreading	Dense	28
Kandhari	2.95	2.58	2.46	Spreading	Medium	25
Jodhpur Red	3.31	2.98	2.88	Spreading	Medium	23
Jalore Seedless	2.35	2.06	2.03	Spreading	Medium	23
Basein Seedless	2.64	2.19	2.12	Spreading	Medium	21
Wonderful	2.61	2.18	2.06	Spreading	Medium	22
S1	2.34	2.08	2.01	Spreading	Dense	26
S2	2.42	2.10	2.02	Spreading	Dense	26
CD (P=0.05)	0.12	0.12	0.10	--	--	1.1

Table 2: Leaf blade size, shape, leaf petiole length, leaf apex shape and anthocyanin's coloration in pomegranate varieties

Variety	Leaf blade length (cm)	Leaf blade width (cm)	Leaf blade shape	Leaf petiole Length (mm)	Leaf apex shape	Anthocyanins coloration
Mridula	8.30	2.82	Lanceolate	6.67	Obtuse	Medium
Bhagwa	4.82	1.65	Lanceolate	6.00	Obtuse	Medium
Ganesh	5.00	2.02	Broad elliptic	6.00	Rounded	High
Kandhari	7.14	2.17	Lanceolate	9.00	Obtuse	Low
Jodhpur Red	6.44	2.39	Broad elliptic	5.66	Acute	High
Jalore Seedless	6.52	2.45	Broad elliptic	7.34	Obtuse	Medium
Basein Seedless	7.76	2.57	Lanceolate	8.67	Obtuse	Low
Wonderful	6.54	2.56	Lanceolate	7.33	Acute	High
S1	6.54	2.23	Lanceolate	6.67	Obtuse	High
S2	7.04	2.19	Lanceolate	7.33	Obtuse	High
CD (P=0.05)	0.95	0.45	--	0.33	--	--

Basein Seedless, Kandhari, Wonderful, S1 and S2 showed lanceolate type of leaf blade shape, however Jodhpur Red, Ganesh and Jalore Seedless had broad elliptic type of leaf shape. The variation in shape of leaf blades among different germplasm might be due to a genetic trait of a particular variety. Nath and Randhawa (1959) also observed similar type of variation. They found ovate lenceolate leaf shape with the acute apex. Muscat White, broadly lanceolate leaf shape with the blunt apex in cv. GBG-1 and lanceolate leaf shape with acute apex in Dholka.

Leaf petiole length was maximum in Kandhari (9 mm), which was significantly higher than all other varieties except Basein Seedless (8.67 mm) which was statistically at par with variety Kandhari. However, minimum leaf petiole length (5.66 mm) was observed in variety Jodhpur Red. The possible reason for difference in petiole length and petiole width among the pomegranate germplasm might be due to genetic makeup and environmental factors. Mridula, Bhagwa, Kandhari, Jalore Seedless, Basein Seedless, S1 and S2 had an obtuse type of leaf apex shape, Jodhpur Red and Wonderful had an acute type, whereas Ganesh had rounded type of leaf apex shape (Table 2). The variation in leaf apex shape might be due to a genetic feature of a particular variety. Data on petiole anthocyanins coloration in pomegranate varieties was represented as low, medium and high (Table 2). Results showed that varieties Kandhari and Basein Seedless had low anthocyanins coloration, Mridula, Jalore Seedless, Bhagwa had medium and Ganesh, Jodhpur Red, Wonderful, S1 and S2 had high petiole anthocyanins coloration.

CONCLUSION

There was ample variation in different pomegranate germplasm in plant height and plant spread were found maximum in Bhagwa. Leaf blade size and shoot thorniness were maximum in Mridula and petiole length was maximum in Kandhari.

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