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Morphometric and Quality Traits Performance in Wild Pomegranate (Daru)

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ABSTRACT: The study aimed to investigate the morphometric variability and quality traits performance in Wild Pomegranate (Daru) in ten seed sources spread across five districts of Himachal Pradesh during 2017-2018. The phenotypic characters (*i.e.* tree height, tree diameter, crown spread (N-S) and crown spread (E-W)), floral biology, fruit morphological characteristics (*i.e.* fruit shape, fresh fruit weight, fruit length, fruit width, fresh seed weight) and biochemical analysis (*i.e.* TSS, total sugar, reducing sugar, non-reducing sugar, acidity) of fruits were recorded. Significant variability in phenotypic, fruit morphological, and biochemical traits have been found among seed sources, providing room for further development of the breeding strategy for wild pomegranates (Daru). Fruit selection is an important method in pomegranate breeding projects since the wild pomegranate is typically grown from seeds, which tends to produce heterozygosity and variances. Therefore, it is essential to start the study project on the reproductive side, keeping in mind the vast potential for improvement and breeding of wild pomegranate (Daru), on the basis of its reproductive characteristics, fruit variations, and also the socio-economic value.

Keywords: Phenotypic, morphology, seed source, wild pomegranate, Daru.

INTRODUCTION

The wild pomegranate (Daru) is a member of the Punicaceae family, indegeneous to Iran (Persia) and is the oldest fruit known to mankind. It has been grown in a variety of agro-climatic conditions. In temperate climates, it is deciduous, but in tropical and subtropical climates, it is evergreen or partially deciduous. The Western Himalayan areas, which include states like Himachal Pradesh, Jammu & Kashmir, and Uttarakhand, this fruit grows in wild (Pandey *et al.,* 2008). In the Himachal Pradesh foothills, there are several wild varieties of pomegranate that can be used to make "Anardana" (Singh and Singh 2006). It is evenly distributed throughout the districts of Solan, Sirmour, Mandi, Shimla, Kullu, and Chamba in Himachal Pradesh (Bhrot, 1998). Wild pomegranate may be cultivated in a variety of soil types, although it thrives in effectively drained light and medium soils. In light soils, fruit quality and colour development are good, while in heavy soils, they are poor. The 'Daru' fruit has therapeutic and medical value, as well as excellent storage properties. The arils (seeds) have a delicious flesh that ranges from white to crimson red. Plant blossom during the spring season in North India, although they bloom all year in Central and South India. According to Nath and Randhawa (1959b) there are three well defined flowering seasons *i.e.* Ambe bahar (February-March), Marig bahar (June-July) and Hasth bahar (September-October).

Some wild pomegranate cultivars have relatively soft seeds, while others have huge, hard seeds. The principal sugars in the fruit are glucose and fructose. The edible part of fruit is rich in minerals, vitamins, sugar, acids, polysaccharides, and polyphenols (Gil *et al.,* 2001; Kulkarni *et al.,* 2004) and also are rich source of anthocyanins and hydrolysable tannins (Wu and Tian 2017). Because of its therapeutic qualities, most locally developed wild cultivars are farmers' selections that are being maintained through vegetative multiplication. However, the wild pomegranate germplasm in the Himalayan region is rapidly disappearing as a result of human encroachment (Rana *et al.,* 2012; Khan *et al.,* 2014). Exploiting the ex situ conserved genetic diversity of the wild pomegranate is essential to prevent difficulties caused by the modern cultivars' limited genetic diversity in the future. This is because the wild pomegranate evolved in response to a variety of environmental pressures. The many aspects of the

domestication process and the causes of its genetic diversification can be illustrated through studies on the genetic variety of wild pomegranates (Langlie *et al.*, 2014). There is a requirement to undertake genetic characterization and breeding potential studies on the selected seed sources in order to harness genetic values through progeny evaluation and multiplication.

MATERIAL AND METHODS

Current study was carried out during 2018 in the Department of Tree Improvement and Genetic Resources, College of Forestry, Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh. Seed sources included Narag (S_1) and Neripul (S_2) district Sirmour, Waknaghat (S_3) and Sadhupul (S_4) district Solan, Basantpur (S_5) district Shimla, Sundernagar (S_6), Rewalsor (S_7) and Aut (S_8) district Mandi, Mohal (S_9) and Banjar (S_{10}) district Kullu were selected (Table 1)**.** Five middle sized trees approximately of same age group were selected on the basis of their height, diameter, crown spread, suitability and general acceptability. Nine flowers were tagged on each tree to study sex ratio, flower type at pre-anthesis stage and after anthesis these were categories into three groups *viz*; hermaphrodite, intermediate and male flowers. Five medium sized fruits from each plant were randomly collected for physico-chemical analysis. A digital calliper was used to measure the size of the fruit. The TSS was calculated using a hand refractometer. By titrating the known volume of juice with 0.1 N NaOH and using phenolphthalein as an indicator, the titrable acidity was calculated. (AOAC 1998). Statistical analysis was done using RBD and CRD experimental designs.

RESULTS

The average mean values of phenotypic characters have been depicted in Table 2. The maximum tree diameter and tree height were recorded from Neripul seed source which shows potential of phenotypic superiority.

All three types of flowers; hermaphrodite, intermediate, and male were counted, and it was found that the percentage of hermaphrodite blooms varied between different seed sources.Among the type of flowers studied in all the seed sources, hermaphrodite flower was observed maximum accounting for 54.00 per cent in Waknaghat followed by intermediate flowers (30.81%) in Aut and male flower (23.45%) in Narag (Table 3). The results are consistent with the findings of Nath and Randhawa (1959a), Nalawadi *et al.* (1973) and Singh et al. (1978) for pomegranate cultivars. The maximum percentage for hermaphrodite flowers observed in Waknaghat *i.e.* 54.00 per cent. Intermediate flowers have been observed maximum in Aut 30.81 per cent. Likewise, maximum percentage for male flowers has been recorded in Narag *i.e.* 23.45 per cent.

Results for fresh fruit weight showed significant variation among seed sources with maximum mean value of 41.69 g found in Basantpur. Fruit length and fruit width was recorded maximum for Banjar (S_{10}). Fresh seed weight also showed significant variation among seed sources. Results computed in Table 4 revealed that Neripul (S_2) had maximum fresh seed weight of 26.96 g.

Table 1: Seed sources of wild pomegranate.

District	Seed source	Code	Altitude m (a.m.s.l.)	Latitude	Longitude
Sirmour	Narag	S_1	1320	30.8170° N	77.1881° E
	Neripul	S_2	1148	31.0197° N	77.3787° E
Solan	Waknaghat	S_3	1500	31.0079° N	77.0881° E
	Sadhupul	S_4	1180	30.9964° N	77.1622° E
Shimla	Basantpur	S_5	1150	31.2081° N	77.1744° E
Mandi	Sundernagar	S_6	900	31.5299° N	76.8889° E
	Rewalsor	S_7	800	31.6322° N	76.8332° E
	Aut	S_8	1050	31.7430° N	77.2082° E
Kullu	Mohal	S_9	1220	31.9149° N	77.1169° E
	Banjar	S_{10}	1250	31.6377° N	77.3441° E

Table 2: Variation in phenotypic characters.

Seed source	Tree height (m)	Tree diameter (cm)	Crown spread (m) (N-S)	Crown spread (m) (E-W)
	Average mean values			
S_1	3.96	9.43	5.45	3.40
S_2	8.35	14.72	14.48	5.12
S_3	6.93	10.72	13.49	3.92
S_4	7.11	11.79	7.28	5.67
S_5	8.16	13.93	7.33	4.97
S_6	7.69	11.89	6.93	5.01
S_7	6.74	11.68	6.36	4.55
S_8	6.47	10.23	5.83	3.81
S_9	7.92	13.23	7.12	5.53
S_{10}	5.57	9.78	5.58	3.72
CD	0.13	2.06	5.31	0.17

Table 3: Percentage of flower types in wild pomegranate.

Seed Source	Hermaphrodite (%)	Intermediate (%)	Male (%)
S_1	46.34	30.21	23.45
S_2	53.00	26.00	21.00
S_3	54.00	27.66	18.34
S_4	52.00	30.78	17.22
S_5	52.89	28.11	19.00
S_6	51.03	28.97	20.00
S_7	50.67	30.33	19.00
S_8	48.81	30.81	18.00
S_9	49.78	30.22	20.00
S_{10}	50.01	28.88	21.11
Mean	50.85	29.19	19.71

Table 4: Variation in fruit characteristics.

Seed source	Fruit shape	Fresh fruit weight (g)	Fruit length (mm)	Fruit width (mm)	Fresh seed weight
	Average mean values				
S_1	Round	8.09	3.64	4.21	0.52
S_2	Round	0.62	6.83	5.56	6.96
S_3	Round	2.72	9.71	0.83	2.66
S_4	Round	5.44	6.55	6.82	8.20
S_5	Oval	1.69	3.53	4.35	3.34
S_6	Oval	0.95	3.65	5.20	8.45
S_7	Round	7.76	0.01	9.09	5.81
S_8	Oval	3.26	5.19	5.77	4.94
S_9	Round	5.88	6.46	8.65	8.96
S_{10}	Round	5.87	8.83	9.53	6.86
CD	-	6.71	3.78	3.42	6.11

Table 5: Variation in bio chemical analysis of fruits.

Seed source	Total sugar (%)	Reducing sugar (%)	Non-reducing sugar (%)	T.S.S.	Acidity (%)
	Average mean values				
S1	7.92	6.20	1.63	10.78	7.11
S2	8.69	6.01	2.54	11.32	6.81
S3	7.87	5.25	2.48	10.22	6.98
S4	7.82	5.12	2.56	9.61	7.24
S5	10.46	8.31	2.04	13.21	5.94
S6	12.81	10.01	2.66	15.01	5.04
S7	11.22	8.86	2.24	13.78	90
S8	8.00	6.41	1.51	10.91	7.05
S9	9.85	7.22	2.49	12.62	6.02
S10	10.96	8.41	2.42	13.41	5.86
Range	7.82-12.81	5.12-10.01	1.51-2.66	9.61-15.01	5.04-7.24
Mean	9.56	7.18	2.26	12.08	6.39
CD	0.29	0.09	0.08	0.09	0.09

Variation in total sugar content was found to be significant for different seed sources. It is evident from the Table 5 that total sugar and reducing sugar content varied between 7.82 to 12.81 per cent and 5.12 to 10.01 per cent, respectively. Highest sugar contents (12.81%) and reducing sugar (10.01%) was recorded for fruits collected from Sundernagar seed source. Non reducing sugar values varied from 1.51 to 2.66 per cent and has been computed highest for Sundernagar (2.66%). Total soluble solids varied from 9.61 to 15.01 per cent and has been recorded highest in Sundernagar seed source (15.01%). Titrable acidity varied from 5.04 to 7.24 per cent and was recorded higher in Sadhupul (7.24%). Sharma and Thakur (2018) computed in their study that wild form of pomegranate fruits are similar to cultivated pomegranates for various traits but exceptionally have higher acidity in comparison of cultivated one.

DISCUSSION

A. Tree phenotypic characters

Phenotypic characters are of first and foremost importance for species improvement. Phenotypic traits exhibit great significance and showed considerable genetic variability within seed sources. The mean average height of trees varied from 3.96 to 8.35 m, tree diameter varied from 9.43 to 14.72 cm and crown spread (N-S) range observed from 5.45 to 14.48 cm and crown spread (E-W) ranged between 3.40 to 5.67 m (Table 2). These characters were used as a criterion for selecting the trees. The findings were similar to Joshi and Joshi, (2001) study, which indicated that this

species has been found in Kathmandu, Nepal and can grow up to heights of 5 to 10 metres.

B. Floral biology

On the basis of the length of the pistil relative to the filament and stamen, three types of flowers were identified: hermaphrodite, male, and intermediate. Lawrence (1951), Watson, and Dallwitz (1992) concurred with these findings. Based on the length of the pistil and the shape of the bloom, they divided pomegranate flowers into three categories. Bell-shaped flowers were considered as male, whereas vase-shaped flowers were hermaphrodites. While working on pomegranate cultivars, Nath and Randhawa (1959a) provided the criteria for projecting floral kinds and documented the presence of functionally unisexual male flowers. The hermaphrodite or perfect flowers have long style, protruding distinctly through staminal column.

B. Fruit morphological and Biochemical studies

The most promising individuals were chosen based on key commercial characteristics such as fruit size and TSS. According to Samadia and Pareek (2006), there was significant variation between individuals in all fruit quality characters. The best-performing individuals with outstanding fruit quality may be further examined for high production potential after multiplication.

CONCLUSION

The fact that wild pomegranates saw less insect pest attacks during the survey of different seed sources suggests selection and hybridization as a means of improving commercially grown *Punica granatum* L. cultivars. The current study's findings include seed source, for which it was discovered that there is heterogeneity in morphological features and fruit quality both between and within seed sources. Using a combination of individual tree selections, particularly for fruit traits, the wild pomegranate improvement initiatives are highlighted as a step toward examining enhanced genotype in the wild pomegranate populations.

FUTURE SCOPE

Despite being a kind of wild tree, biochemical investigations have shown that the fruits of this tree have a high level of quality. In terms of growth and fruit quality characteristics, this study aids in the identification of superior genotypes in Himachal Pradesh. The best fruits can be processed for use in the pharmaceutical and medical industries. Fruit pulp can be used as biofuel and in the woodworking industry. You can grow this agroforestry wild fruit tree beside agricultural fields on bunds.

Author's Contribution

Conceived and designed the analysis: Tara Gupta, Anmol Negi
Collected the data: Anmol Negi, Shweta, Sushmita
Contributed data or analysis tools: Anmol Negi, Aman Mahajan, Vipul Sharma
Performed the analysis: Anmol Negi, Vipul Sharma, Sushmita Thakur, Aman Mahajan
Wrote the paper: Anmol Negi

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