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Variation in morphological descriptors among different populations of *Grewia optiva* Drummond (Beul) in Himachal Pradesh

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Abstract

Fifteen Populations of superior plus trees (20-30cm diameter) of *Grewia optiva* Drummond (Beul) have been selected for study in three districts viz; Kangra, Hamirpur, and Mandi of Himachal Pradesh. To study the variation in morphological descriptors among different populations, all the qualitative, quantitative and pseudo qualitative characteristics were recorded. On the basis of overall scoring index of useful desired traits, the population site (Bharnoi-MN5) has proved the superior population. Whereas the population site; (Balt-MN4), and (Old Kangra-KR3) were statistically at par and both populations are ranked at number 2. Hence, these populations are significantly proved the best sources, on the basis of natural phenotypically observations and scoring index on each individual traits for selection and screening of superior individuals within the populations, so as to get improved genetic gain and establishment of gene bank of superior families and best genotypes of the families.

Keywords: *Grewia optiva*, morphological descriptor, variation, diameter class, cropland, Beul, population

Introduction

Grewia optiva Drummond locally called as 'Beul' is an important agroforestry tree species of the low and mid hill regions in the Western and Central Himalayas, which constitutes 44 genera and 400 species, distributed globally throughout the tropical, sub-tropical and temperate regions of the world. In hilly and mountain regions, the demand of feeds and fodder for livestock is much higher than their availability (Singh and Bimal, 2004) [16]. *Grewia optiva* Drummond (Beul) is one of the most important tree species used as fodder in Himachal Pradesh (Singh, 2005) [15]. It belongs to family Tiliaceae and naturally distributed in India, Bhutan, Nepal, and Pakistan. There are about 150 species in the world, 42 in India and 5 in Himachal Pradesh (Hooker, 1875) [7]. *Grewia optiva* is very important multipurpose or agroforestry tree species having the chromosome number $2n=18$ (Coleman, 1982) [5] and popular for its utility as fodder, fuel and fiber. It is a small to medium sized deciduous tree, 5-12 m in height; Crown spreading; bole clear, 3-4 m and about 1m in diameter. Branches smooth pale silvery brown; bark dark brown, thick and roughish, exploiting in small woody scales. Leaves opposite, ovate, acuminate, closely serrate, rough and hairy. Fruit is a drupe, 1-4 locked, olive green and black when ripe (Troup, 1921) [17]. Leaves are shed in March and April and new ones appear in the month of April to May. The fruits are formed soon after and attain full size by September, ripening between October and December. The fruits are borne on previous year's shoots. The first pre-requisite step to undertake breeding and tree improvement programme and to obtain improved genetic gain is the selection of best population and best individuals within the population, to select finally best families and best genotypes of the best families. Hence, present study was undertaken to study variation in morphological descriptors among different populations to select plus trees (superior trees) of *Grewia optiva* Drummond (beul) in Himachal Pradesh.

Materials and Methods

The study on *Grewia optiva* Drummond (Beul) has been undertaken in low and mid hills zones at different sites of Himachal Pradesh. The present study was carried out in 2nd phase in another three districts of Himachal Pradesh i.e. Kangra, Mandi and Hamirpur, keeping in view the rich genetic diversity and phenotypically superior plant populations of *Grewia optiva*. The criteria selection of superior plants within the 15 populations was 20-30 cm diameter class. The population includes six superior plants on the same site, which is identified, marked and data is presented as mean value of six superior plus trees.

Variation in leaf characteristics, plant characteristics and fruit characteristics among different populations were undertaken as per standard methodology suggested by (Robinson *et al.* 1951) [12] and (Al- Jibouri *et al.* 1958) [1]. The variation in leaf characteristics (leaf length in cm, leaf width in cm, leaf area in cm², leaf petiole length in cm, fresh weight of 100 leaves in g and dry weight of 100 leaves in g), plant characteristics (plant height in m, plant diameter in cm, plant crown/spread in m, number of primary branches, number of secondary branches and primary branches angles) and fruit measurement characteristics (fresh weight of 100 fruits in g, dry weight of 100 fruits in g, fruit length in mm, fruit width in mm and fruit thickness in mm) were as per method adopted by (Kaushal PS.1978) [9]. Data has been analyzed statistically as per method suggested by (Panse and Sukhatme, 1967) [10] and (ISTA 1966) [8]. The table of analyses of variance (ANOVA) was set and used as explained by (Gomez 1984) [6]. Altitude ranged 1318 m to 445 m a msl in the study area and altitude related observations were recorded with the help of Global-Positioning System (GPS) and GPS mobile app. Scoring of morphological leaf characteristics, plant characteristics, fruit and seed characteristics obtained/ given on each desired traits out of 10 marks and overall mean is also scored out of 10 marks for each individual traits. Ranking of all selected population were calculated on the basis of mean value scoring index of each desired and useful traits under study.

Results and Discussion

To study the variation in leaf, plant growth and fruit and seed characteristics all the qualitative, quantitative and pseudo qualitative characteristics were recorded, on the basis of overall scoring index of useful and desired characteristics. The population site Bharnoi, (MN5- 1318m a msl) has been considered and found as the best population. Whereas, the population sites Balt (MN4 -845m a msl) and Old Kangra (KR5 1046m a msl), are statistically at par and ranked at number 2. These are the sources/populations, which are most appropriate for fodder quality parameters among all other populations. These populations are statistically significant the best one, over other populations under study and proved best sources, on the basis of natural phenotypically observation on desired and useful traits.

Variation in leaf characteristics among different populations of *Grewia optiva* Drummond is presented (Table -1) in selected sites; The population site Bharnoi (MN5) has the maximum leaf length (11.89cm), maximum leaf width (7.19cm), maximum leaf area (65.06cm²) and has the maximum fresh weight (105.44g) as well as maximum dry weight (50.94g) of the 100 leaves. Whereas the population site Janhen (HM1) has the minimum leaf length (9.22cm), minimum leaf width (5.25cm), minimum leaf area (46.42cm²) and has the minimum fresh weight (46.28g) as well as dry weight (23.22g) of 100 leaves. The population site Bagla (MN3) has the maximum leaf petiole length (1.29cm), whereas the population site Dohren (KR4) has the minimum leaf petiole length (0.97cm).

Table 2 explains the variation in plant characteristics among the different populations (between 20-30 diameter class) growing on cropland situation in selected sites. The population site Bhalet (HM5) has the maximum plant height (8.57m) and has the maximum plant crown / spread (4.63m). Whereas the population site Gangal (MN2) has the minimum plant height (3.73m) and has the minimum plant crown/spread (1.63m). The population site Janhen (HM1) has the maximum diameter (29.63cm) and the maximum number of

primary branches (6.67). Whereas the population site Gangal (MN2) has the minimum plant diameter (12.01cm) and has the minimum number of plant primary branches (2.67). The population site Old Kangra (KR3) has the maximum number of plant secondary branches (11.83), whereas the population site Balla (KR5) has the minimum number of plant secondary branches (3.83). The population site Balla (KR5) has the maximum primary branches angle (40.83°), whereas the population site Balt (MN4) has the minimum primary branches angle (21.67°).

Data presented in Table 3 reveals the variation in fruit measurement characteristics among different population of *Grewia optiva* Drummond in selected site. The population site Bharnoi (MN5) has the maximum fresh weight (23.20g) as well as maximum dry weight (15.70g) of 100 leaves. Whereas the population site Balla (KR5) and the population site Gangal (MN2) has recorded the minimum fresh weight (20.35g) as well as dry weight (12.14g) of 100 fruits. The population site Harbel Neri (HM3) has the maximum fruit length (6.26mm), whereas the population site Patta (MN1) has the minimum fruit length (5.59mm). The population site Gangal (MN2) has the maximum fruit width (5.12mm), Whereas the population site Old Kangra (KR3) has the minimum fruit width (4.60mm). The population site Anu Khurd (HM4) has the maximum fruit thickness (5.20mm), Whereas the population site Baluglua (KR2) has the minimum fruit thickness (4.29mm).

Scoring index of morphological leaf characteristics of selected population of *Grewia optiva* (Table-4) obtained on each desired traits out of 10 marks. The population site Bharnoi (MN5) has the maximum score of leaf length (9.80), leaf width (9.60), fresh weight of 100 leaves (10.00) and has the maximum score of dry weight of 100 leaves (9.80). Whereas the population site Janhen (HM1) has the minimum score of leaf length (5.40), leaf width (6.40), fresh weight of 100 leaves (6.0) and has the minimum score of dry weight of 100 leaves (6.10). The population site Old Kangra (KR3) has the maximum score of leaf area (10.00), where as the population site Dohran (KR4) has the minimum score of leaf area (6.50). The population site Bhalet (HM5) has the maximum score of leaf petiole length (9.9), whereas the population site Dohran (KR4) has the minimum score of leaf petiole length (6.7)

Scoring index of plant characteristics (Table-5) of selected population of *Grewia optiva* obtained on each desired morphological plants traits out of 10. The population site Bhalet (HM5) has the maximum score of plant height (10.00) and has the maximum score of plant crown spread (10.00). whereas the population site Balla (KR5) and population site Gangal (MN2) has minimum score of plant height (6.90) and has minimum score of plant crown spread (5.20). The population site Janhen (HM1) has the maximum score of plant diameter (9.80), plant primary branches (10.00) and has the maximum plant secondary branches (9.80). Whereas the population site Gangal (MN2) has the minimum score of plant diameters (6.10) and has minimum score of plants primary branches (5.00). The population site Balla KR5 has the minimum score of plant secondary branches (5.00). The population site Katoi (KR1) has the maximum score of plant primary branches angle (10.00), where as the population site Harbal Neri (HM3) has the minimum score of plant primary branches angle (7.00).

Scoring index of seed and fruit characteristics (Table -6) obtained on each desired traits out of 10. The population site Bharnoi (MN5) has the maximum score for fresh weight of

100 fruits (10.00), where as the population site Bagla (MN3) has the minimum score of fresh weight of 100 fruits (5.00) The population site Balla (KR5) has the maximum score of dry weight of 100 fruits (10.00) where as the population site Gangal (MN2) has the minimum score of dry weight of 100 fruits (5.00). The population site Habal Neri (HM3) has the maximum score of fruit length (10.00). Whereas the population site Bhalet (HM5) has the minimum score of fruit length (5.00). The population site Gangal (MN2) has the maximum score of fruit width (10.00) where as the population site Old Kangra (KR3) has the minimum score of fruit width (5.00). The population site Balt (MN4) has the maximum score of fruit thickness (10.00), where as the population site Old kangra has the minimum score of fruit thickness (5.00).

Scoring value of desired morphological descriptors in selected population of *Grewia optiva* Drummond (Table 4-6) has been given marks for each individual traits out of 10. Mean value of scoring index represents the ranking wise position of selected population (Table -7 and Fig.1), The population site Bharnoi MN5 (8.62) recorded as ranked 1st. Whereas the population site Balt MN4 (8.21) and Old Kangra (KR2) ranked as 2nd and 3rd respectively.

Similar kind of results have been reported by (Bhagta 2015)

[2], (Sankhyan *et al.* 2019) [13], (Sankhyan *et al.* 2020) [14], (Bhagta *et al.* 2019) [3], (Sheeraz Saleem Bhat 2010) [4] and (Rathore Amandeep 1997) [11], in *Grewia optiva* and our findings are in conformity with the results of different researchers on this particular crop. However, site specific variation exists there in on account of prevailing environmental conditions, climatic factors and locality factor of the ecological niches underneath different populations. It is concluded that the population site Bharnoi (MN5) has been considered and found as the best population and the population sites Balt (MN4) and Old Kangra (KR2) are statistically at par and ranked at number 2. The study concludes with the finding that population sites Bharnoi, Balt and Old Kangra are superior among other populations, which can be used for tree improvement programme and other breeding purposes on the basis of phenotypically superiority which may help in selection of best individuals with in the population for developing seedling seed orchard/ common garden of superior families, so as to obtain improved genetic gain. The study may also help to develop 1.5 generation seedling seed orchard and establishment of genebank of superior families and best genotypes of the best families.

Table 1: Variation in leaf characteristics among different populations of *Grewia optiva* Drummond (Beul)

Districts	Population code	Population Site	Population altitude above mean sea level (m)	Leaf length (cm)	Leaf width (cm)	Leaf area (cm ²)	Leaf petiole Length (cm)	Fresh weight of 100 leaves(g)	Dry weight of 100 leaves(g)
Kangra	KR1	Katoi	500	10.50	6.68	63.81	1.0	68.89	24.67
	KR2	Baluglua	445	10.54	6.00	65.93	1.07	77.67	31.11
	KR3	Old Kangra	639	11.82	6.55	67.77	1.1	83.66	28.33
	KR4	Dohran	897	10.16	6.12	47.06	0.9	75.06	28.22
	KR5	Balla	1046	11.14	6.77	53.80	1.1	85.87	31.89
Hamirpur	HM1	Janhen	802	9.22	5.25	46.42	1.07	56.28	23.22
	HM2	Jhinhkari	818	10.09	6.27	55.24	1.07	85.44	31.06
	HM3	Harbal Neri	625	10.37	5.64	55.54	1.1	66.61	25.78
	HM4	Anu Khurd	765	10.94	5.90	59.58	1.06	74.28	26.06
	HM5	Bhalet	708	10.42	5.96	54.06	1.08	89.78	30.39
Mandi	MN1	Patta	554	10.88	6.75	57.89	1.05	84.28	35.94
	MN2	Gangal	737	10.53	6.74	55.49	1.2	80.39	36.11
	MN3	Bagla	764	11.54	6.78	62.18	1.2	95.17	44.17
	MN4	Balt	845	11.52	6.46	62.26	1.2	102.73	45.11
	MN5	Bharnoi	1318	11.89	7.19	65.06	1.27	105.44	50.94
	CD	0.05		1.65	1.62	6.26	2.45	12.53	4.87

Table 2: Variation in plant characteristics among different populations of *Grewia optiva* Drummond (Beul)

Districts	Population code	Population sites	Population altitude above mean sea level (m)	Plant height (m)	Plant diameter (cm)	Plant crown spread(m)	Plant primary branches (Nos.)	Plant secondary branches(Nos.)	Plant primary branches angle (°)
Kangra	KR1	Katoi	500	5.93	19.46	2.66	4.67	6.67	33.83
	KR2	Baluglua	445	7.10	18.72	2.25	4.50	6.33	31.67
	KR3	Old Kangra	639	7.10	26.64	4.19	5.67	11.83	40.00
	KR4	Dohran	897	5.98	21.80	3.05	4.83	8.50	23.33
	KR5	Balla	1046	4.50	15.39	2.33	2.67	3.83	40.83
Hamirpur	HM1	Janhen	802	6.80	29.63	3.38	6.67	10.33	35.33
	HM2	Jhinhkari	818	5.75	22.95	3.50	4.00	7.67	31.17
	HM3	Harbal Neri	625	5.93	21.00	2.50	3.00	4.33	24.17
	HM4	Anu Khurd	765	4.83	17.28	2.28	3.50	4.00	33.33
	HM5	Bhalet	708	8.57	23.12	4.63	3.50	7.17	30.00
Mandi	MN1	Patta	554	5.67	19.48	2.21	5.33	10.50	31.67
	MN2	Gangal	737	3.73	12.01	1.63	2.67	4.83	39.50
	MN3	Bagla	764	5.20	16.97	2.50	4.33	6.67	27.50
	MN4	Balt	845	6.63	15.03	1.89	4.33	7.83	21.67
	MN5	Bharnoi	1318	6.10	15.92	2.79	4.33	8.83	30.00
	CD	0.05				1.13	1.82	1.70	7.04

Table 3: Variation in Plant Fruit Measurement Characteristics among different populations of *Grewia optiva* Drummond (Beul)

Districts	Population code	Population sites	Population altitude above mean sea level	Fresh weight of 100 Fruits(g)	Dry weight of 100 fruit (g)	Fruit length (mm)	Fruit width (mm)	Fruit thickness (mm)
Kangra	KR1	Katoi	500	20.90	14.62	5.90	4.96	4.90
	KR2	Baluglua	445	20.84	13.80	5.60	4.85	4.29
	KR3	Old Kangra	639	21.8	14.80	6.16	4.60	4.58
	KR4	Dohran	897	21.50	15.40	5.97	4.62	5.03
	KR5	Balla	1046	20.35	13.97	5.95	4.68	4.90
Hamirpur	HM1	Janhen	802	21.58	14.62	5.84	4.80	4.87
	HM2	Jhinjhkari	818	21.41	14.4	6.23	4.93	4.84
	HM3	Harbal Neri	625	21.60	13.40	6.26	4.93	5.07
	HM4	Anu Khurd	765	20.53	12.72	6.21	4.79	5.20
	HM5	Bhaleth	708	22.40	12.20	5.43	4.95	4.84
Mandi	MN1	Patta	554	21.7	14.14	5.59	4.82	4.84
	MN2	Gangal	737	21.48	12.14	6.04	5.12	4.80
	MN3	Bagla	764	20.4	12.34	5.70	5.04	5.08
	MN4	Balt	845	21.95	13.6	6.09	4.82	5.43
	MN5	Bharnoi	1318	23.20	15.7	5.69	5.03	4.80
	CD	0.05		3.06	2.70	1.36	1.47	0.96

Table 4: Scoring Index on desired morphological Leaf Characteristics of selected population *Grewia optiva* Drummond under Study

Districts	Population Site	Leaf length (cm)	Leaf length Score	Leaf width (cm)	Leaf width Score	Leaf area (cm ²)	Leaf area Score	Leaf petiole Length (cm)	Leaf petiole Length Score	Fresh weight of 100 leaves(g)	Fresh weight of 100 leaves Score	Dry weight of 100 leaves(g)	Dry weight of 100 leaves Score	Mean score value
Kangra	Katoi	10.50	7.50	6.68	8.30	63.81	9.40	1.1	8.5	68.89	7.20	24.67	6.20	7.85
	Baluglua	10.54	7.60	6.00	8.20	65.93	9.70	1.7	9.6	77.67	7.60	31.11	6.70	8.23
	Old Kangra	11.82	9.20	6.55	8.40	67.77	10.00	1.1	8.3	83.66	8.20	28.33	6.10	8.30
	Dohran	10.16	8.20	6.12	8.40	47.06	6.50	0.9	6.7	75.06	7.80	28.22	6.30	7.31
	Balla	11.14	9.70	6.77	8.80	53.80	8.60	1.1	8.4	85.87	8.70	31.89	6.90	8.51
Hamirpur	Janhen	9.22	5.40	5.25	6.40	46.42	6.20	1.7	9.6	56.28	6.00	23.22	6.10	6.61
	Jhinjhkari	10.09	7.70	6.27	8.50	55.24	8.20	1.7	9.7	85.44	8.60	31.06	6.70	8.23
	Harbal Neri	10.37	8.50	5.64	6.70	55.54	8.30	1.1	8.4	66.61	7.10	25.78	6.40	7.56
	Anu Khurd	10.94	8.70	5.90	6.80	59.58	8.70	1.6	9.7	74.28	7.60	26.06	6.30	7.96
	Bhaleth	10.42	8.20	5.96	6.70	54.06	8.30	1.8	9.9	89.78	8.90	30.39	6.80	8.13
Mandi	Patta	10.88	9.00	6.75	8.40	57.89	8.70	1.5	9.4	84.28	8.50	35.94	7.10	8.51
	Gangal	10.53	7.90	6.74	7.50	55.49	8.60	1.2	8.3	80.39	8.10	36.11	7.20	7.93
	Bagla	11.54	9.40	6.78	8.80	62.18	9.40	1.2	8.4	95.17	9.50	44.17	8.40	8.98
	Balt	11.52	9.30	6.46	8.60	62.26	9.30	1.2	8.3	102.73	10.00	45.11	8.50	9.00
	Bharnoi	11.89	9.80	7.19	9.60	65.06	9.80	1.2	8.4	105.44	10.00	50.94	9.80	9.80
Mean value			8.39		8.00		8.62		8.81		8.25		7.04	

Score obtained and given on each desired morphological leaf traits out of 10

Leaf length (cm)	Score	Leaf width (cm)	Score	Leaf area (cm ²)	Score	Leaf petiole length(cm)	Score	Fresh weight of 100 leaves (g)	Score	Dry weight of 100 leaves (g)	Score
11.89 -10.88	10 -9	7.19 -6.68	10-9	67.77 - 59.58	10-9	1.8 -1.5	10-9	105.44 -80. 39	10-9	50.94 - 44.17	10-9
10.88 - 10.16	8-7	6.68-6.12	8 -7	59.58 - 53.80	8 -7	1.5 - 1.2	8-7	80.39 -74.28	8-7	44.17 - 36.11	8-7
10.16 - 9.22	6-5	6.12 -5.25	6-5	53.80 - 46.42	6-5	1.2 - 0.9	6-5	74.28 - 56.28	6-5	36.11 - 24.67	6-5

Table 5: Scoring Index on desired morphological Plant Characteristics of selected population of *Grewia optiva* under study

Districts	Population sites	Plant height (m)	Plant height (m) score	Plant diameter (cm)	Plant diameter (cm) score	Plant crown spread (m)	Plant crown spread score	Plant primary branches (Nos.)	Plant primary branches score	Plant secondary branches (Nos.)	Plant secondary branches score	Plant primary branches angle (°)	Plant primary branches angle score	Mean score value
Kangra	Katoi	5.93	7.60	19.46	7.80	2.66	7.00	4.67	8.00	6.67	6.00	33.83	10.00	7.73
	Baluglua	7.10	9.10	18.72	7.60	2.25	6.40	4.50	7.40	6.33	5.90	31.67	9.00	7.50
	Old Kangra	7.10	9.10	26.64	9.30	4.19	9.20	5.67	9.20	11.83	10.00	40.00	9.50	9.30
	Dohran	5.98	7.50	21.80	8.20	3.05	8.20	4.83	9.70	8.50	7.80	23.33	7.60	8.10
	Balla	4.50	6.90	15.39	7.80	2.33	6.00	2.67	5.00	3.83	5.00	40.83	10.00	6.70
Hamirpur	Janhen	6.80	8.60	29.63	9.80	3.38	7.90	6.67	10.00	10.33	9.80	35.33	9.50	9.20
	Jhinjhkari	5.75	7.50	22.95	8.40	3.50	8.00	4.00	6.00	7.67	7.80	31.17	9.70	7.90
	Harbal Neri	5.93	7.80	21.00	8.10	2.50	7.30	3.00	6.00	4.33	5.70	24.17	7.00	6.90
	Anu Khurd	4.83	6.70	17.28	6.80	2.28	5.70	3.50	6.50	4.00	5.40	33.33	9.30	6.70
	Bhaleth	8.57	10.00	23.12	8.50	4.63	10.00	3.50	6.00	7.17	7.60	30.00	9.00	8.50
Mandi	Patta	5.67	7.70	19.48	6.70	2.21	5.60	5.33	9.00	10.50	9.60	31.67	9.00	7.90
	Gangal	3.73	6.10	12.01	6.10	1.63	5.20	2.67	5.00	4.83	5.60	39.50	9.80	6.30
	Bagla	5.20	7.30	16.97	6.70	2.50	7.80	4.33	7.40	6.67	6.00	27.50	7.80	7.10
	Balt	6.63	8.50	15.03	6.70	1.89	5.60	4.33	7.40	7.83	8.50	21.67	7.60	7.30
	Bharnoi	6.10	8.40	15.92	6.70	2.79	7.40	4.33	7.40	8.83	8.00	30.00	9.00	7.80
Mean Value			7.87		7.75		7.17		7.34		7.19		8.96	

Score obtained and given on each desired morphological plant traits out of 10

Plant height (m)	Score	Plant diameter (cm)	Score	Plant crown spread (m)	Score	Plant primary branches (Nos.)	Score	Plant secondary braches (NoS.)	Score	Plant primary branch angle (°)	Score
8.57- 6.80	10-9	29.63-22.95	10-9	4.63-3.50	10-9	6.67-5.33	10-9	11.83-8.83	10-9	40.83-30.00	10-9
6.80-5.93	8-7	22.95- 17.28	8-7	3.50-2.33	8-7	5.33-4.67	8-7	8.83-6.67	8-7	30.00-23.33	8-7
5.93- 3.73	6-5	17.28-12.1	6-5	2.33-1.63	6-5	4.67-2.67	6-5	6.67-3.83	6-5	23.33-21.67	6-5

Table 6: Scoring Index on desired morphological Fruit Characteristics of selected population of *Grewia optiva* under study

Districts	Population sites	Fresh weight of 100 Fruits (g)	Fresh weight of 100 Fruits score	Dry weight of 100 fruit (g)	Dry weight of 100 fruit score	Fruit length (mm)	Fruit length score	Fruit width (mm)	Fruit width score	Fruit thickness (mm)	Fruit thickness scoring	Mean score value
Kangra	Katoi	20.90	5.80	14.62	9.20	5.90	9.00	4.96	9.00	4.90	7.00	8.00
	Baluglua	20.84	5.80	13.80	7.50	5.60	7.50	4.85	7.60	4.29	5.00	6.68
	Old Kangra	21.80	7.00	14.80	8.00	6.16	9.00	4.60	5.00	4.58	5.00	6.80
	Dohran	21.50	9.40	15.40	10.00	5.97	9.20	4.62	5.30	5.03	9.00	8.58
	Balla	20.35	5.70	13.97	7.60	5.95	9.50	4.68	5.50	4.90	7.40	7.14
Hamirpur	Janhen	21.58	9.70	14.62	7.80	5.84	7.90	4.80	5.80	4.87	6.60	7.56
	Jhinhkari	21.41	7.90	14.40	7.30	6.23	9.90	4.93	7.80	4.84	6.70	7.92
	Harbal Neri	21.60	9.70	13.40	6.00	6.26	10.00	4.93	7.80	5.07	9.20	8.54
	Anu Khurd	20.53	5.80	12.72	5.70	6.21	9.80	4.79	7.50	5.20	9.40	7.64
	Bhaleth	22.40	9.80	12.20	5.40	5.43	5.00	4.95	7.80	4.84	6.70	6.94
Mandi	Patta	21.70	7.00	14.14	7.60	5.59	5.70	4.82	7.00	4.84	6.70	6.80
	Gangal	21.48	8.00	12.14	5.00	6.04	9.40	5.12	10.00	4.80	6.40	7.76
	Bagla	20.40	5.00	12.34	5.60	5.70	7.00	5.04	9.60	5.08	9.40	7.32
	Balt	21.95	9.40	13.60	5.90	6.09	9.40	4.82	7.00	5.43	10.00	8.34
	Bharnoi	23.20	10.00	15.70	9.80	5.69	5.60	5.03	9.40	4.80	6.40	8.24
Mean value			7.73		7.22		8.27		7.46		7.41	

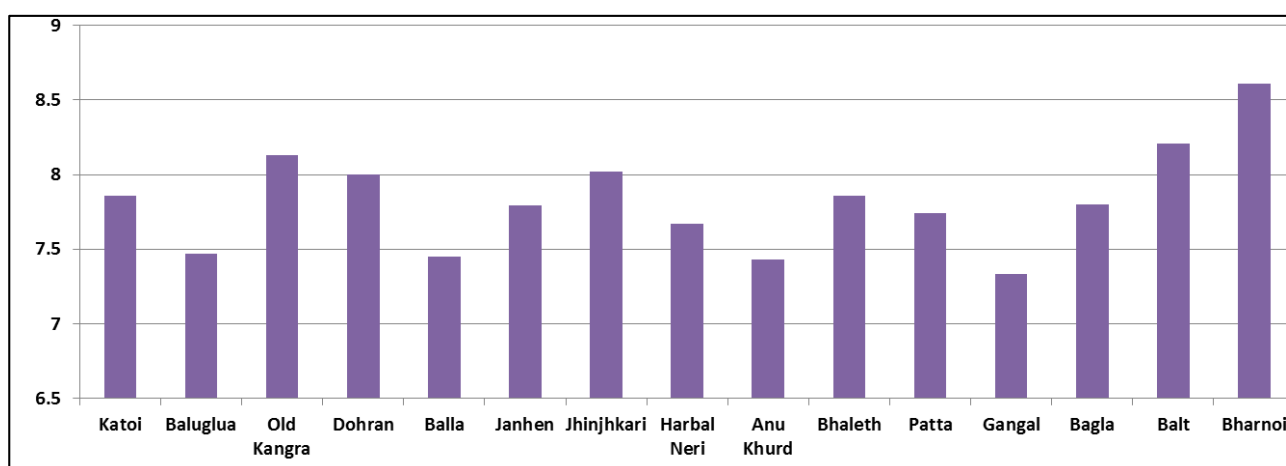
Score obtained and given on each desired morphological Fruit traits out of 10

Fresh weight of 100 Fruits (g)	Score	Dry weight of 100 fruit (g)	Score	Fruit length (mm)	Score	Fruit width (mm)	Score	Fruit thickness (mm)	Score
23.20-21.48	10-9	15.40-14.80	10-9	6.26-5.90	10-9	5.12-4.96	10-9	5.43-5.03	10-9
21.48-21.7	8-7	14.80-13.40	8-7	5.90- 5.70	8-7	4.96-4.82	8-7	5.03-4.03	8-7
21.7-20.4	6-5	13.40-12.14	6-5	5.70- 5.43	5-6	4.82-4.60	6-5	4.90-4.29	6-5

Table 7: Scoring Index on desired morphological Characteristics of selected population *Grewia optiva* Drummond under study for determining ranking status.

Districts	Population sites	Leaf Characters	Plant Characters	Fruit Characters	Mean of all Characters	Ranking Status
Kangra	Katoi	7.85	7.73	8.00	7.86	6 th
	Baluglua	8.23	7.50	6.68	7.47	11 th
	Old Kangra	8.30	9.30	6.80	8.13	3 rd
	Dohran	7.31	8.10	8.58	8.00	5 th
	Balla	8.51	6.70	7.14	7.45	12 th
Hamirpur	Janhen	6.61	9.20	7.56	7.79	8 th
	Jhinhkari	8.23	7.90	7.92	8.02	4 th
	Harbal Neri	7.56	6.90	8.54	7.67	10 th
	Anu Khurd	7.96	6.70	7.64	7.43	13 th
	Bhaleth	8.13	8.50	6.94	7.86	7 th
Mandi	Patta	8.51	7.90	6.80	7.74	9 th
	Gangal	7.93	6.30	7.76	7.33	14 th
	Bagla	8.98	7.10	7.32	7.80	15 th
	Balt	9.00	7.30	8.34	8.21	2 nd
	Bharnoi	9.80	7.80	8.24	8.61	1 st

Mean value is the overall score out of 10 mark

**Fig 1:** Occurrence of Populations of *Grewia optiva* (Beul)**Fig 1:** Scoring index on useful identified morphological characteristics of *Grewia optiva* (Beul) populations.

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References

1. AI- Jibouri HA, Miller RA, Robinson HF. Genotypic and environmental variances and Covariance's in an upland cotton across of interspecific origin. *Agronomy Journal*. 1958; 50:633-637.
2. Bhagta S. Progeny evaluation of open pollinated seedling seed orchard of *Grewia optiva* Drummond. M.Sc. Thesis, Department of Tree Improvement and Genetic Resources, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, India, 2015.
3. Bhagta Shikha, Sankhyan HP, Sharma Dushyant, Ashine Tesfaye. Correlation and path coefficient analyses in *Grewia optiva* Drummond. *International Journal of Chemical studies* 2019; 7(3):746-749.
4. Bhat Sheeraz Saleem. Evaluation of established open pollinated seedling seed orchard of *Grewia optiva* Drummond. Department of Tree Improvement and Genetic Resources, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, 2010, 89.
5. Coleman. Chromosome numbers of angiosperms collected in the state of Sao Paulo. *Brazilian Journal of Genetics*. 1982; 5(3):533-549.
6. Gomez KA, Gomez AA. *Statistical procedures for agriculture research*. A Wiley- Intersciences Publication, New York, 1984, 2 ed., 680.
7. Hooker JD. *Flora of the British India* L. Revue & Co., London, 1875.
8. ISTA. International rules for seed testing. *Proc. Int. Seed Testing Assoc.* 1966; 31:1-152.
9. Kaushal PS. Screening of beul trees (*Grewia optiva*) for superiour nutritative stains M.Sc. Thesis Himachal Pradesh University, 1978, 64.
10. Panse VG, Sukhatme PV. *Statistical methods for Agricultural works*. ICAR, New Delhi, 1967, 610.
11. Rathore Amandeep. Evaluation of selected genotypes of *Grewia optiva*. M.Sc. Thesis Dr. Y.S.P University of Horticulture and Forestry, Nauni- Solan (H.P.), 1997, 55.
12. Robinson HF. Comstock RE. Harvey PH. Genotypic and phenotypic correlation in corn and their importance in selection. *Agronomy Journal*. 1951; 43:282-287.
13. Sankhayan HP, Bhagta Shikha, Thakur Sanjeev. Evaluation of the half sib progenies to identify prepotency of the mother clones of *Grewia optiva* Drummond. *Journal of Pharmacognosy and Phytochemistry* 2019; 8(4):1265-1270.
14. Sankhyan HP. Thakur Sanjeev. Kumar Sunil. Karishma. Prachi. and Chand Krishan. Morphological characteristics among different populations for screening of beul trees (*Grewia optiva*) Drummond. *International Journal of Chemical Studies*. 2020; 8(4):1845-1848.
15. Singh R. Survey of social economic profile of farmers and animals feed resources in the mountains of Himachal Pradesh. *Himalayans Ecology*. 2005; 13(2):12-15.
16. Singh R, Bimal M. Traditional animal raring practices in mountains of Himachal Pradesh. *ENVIS bulletin: Himalayan Ecology*. 2004; 12(1).
17. Troup RS. *Silviculture of Indian Trees*. Clarendroan Press Oxford. 1921; 1:164-166.