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Divergence studies for morphometric and fodder parameters in *Grewia optiva* Drummond

Sheeraz Saleem Bhat[1*] and Suheel Ahmad[2]

[1]Dept. of Tree Improvement and Genetic Resources,
Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan – 173 230, India
[2]Indian Grassland and Fodder Research Institute, Regional Station, Srinagar India
*Corresponding author e-mail: shrzbhat@gmail.com
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Abstract

Genetic divergence was studied for sixty accessions of *Grewia optiva* Drummond collected from eight districts of Himachal Pradesh, using MAHALANOBIS' D^2 Statistics. These progenies were grouped into four clusters, where inter cluster distance indicated higher divergence between Cluster I and Cluster II (5.652). Dendrogram was constructed with the help of SPSS-16 statistical software. Controlled breeding among the progenies of clusters having the maximum mean values regarding the desired characters, especially crude protein, total leaf biomass can be of immense use to attain better planting stock through selection and breeding and to obtain better heterotic vigour through hybridization of the most divergent progenies.

Key words: Clustering, Genetic divergence, *Grewia optiva,* Morphometric and fodder traits

Introduction

Genetic divergence was studied for *Grewia optiva* Drummond (Family Tiliaceae) for its morphometric and fodder characters to delineate the different progenies for cross breeding programmes, as the species possesses wide variability for different traits enabling the breeders for selection and hybridization to achieve more economic gains. It is a tree species of fodder value, supplying green fodder during the lean period in the sub-tropical western Himalayan states such as Jammu and Kashmir upto an elevation of 2,000 m above mean sea level. It is a frost and drought hardy moderate sized tree having good coppicing character. The leaves possess high digestibility and preferred by livestock. The tree is frost hardy but young seedlings die-back due to severe frost during winter. These seedlings are however not killed but resume their growth by throwing out new shoots in the next spring. The flowers appear with new flush of leaves in May. Flower buds are born on one year old shoots in the axils of the leaves. Flowering normally starts in the last week of March and continues till the end of June. It is a cross pollinated species. Honeybees, hover's flies and dipterian flies are the main agents of pollination. Wood is hard, tough and elastic, yellowish white or grey in colour with an unpleasant odour, heavy with even and narrowly interlocked grained and fine texture, used for oar shafts, shoulder poles, cot frames, bows, paddles, tools and axe handles, papermaking, fibre products etc.

Materials and Methods

Seedling orchard of *Grewia optiva* Drummond was established in July, 2000 consisting of 60 accessions each under three replications at spacing of 2 x 2m in three blocks, collected from various districts of Himachal Pradesh, which include Bilaspur (BI-1 to BI-5), Chamba (CH-1 to CH-7), Hamirpur (HA-1 to HA-5), Kangra (KA-1 to KA-3), Mandi (MA-1 to MA-5), Shimla (SH-1 to SH-7), Sirmour (SI-1 to SI-16) and Solan (SO-1 to SO-12 (Table 1, Figure 1).

Fig 1. Map showing the source of different progenies undertaken for divergence studies of morphometric and fodder parameters of *Grewia optiva* Drummond in Himachal Pradesh, India

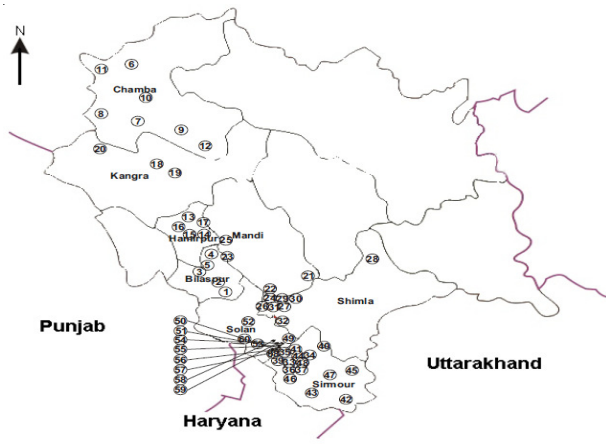

Table 1. Names of progenies in established open pollinated seedling

District	Progeny	Code	District	Progeny	Code
Bilaspur	Bilaspur	BI-1	Shimla	Palyad	SH-6
	Kanduar	BI-2		Taradevi	SH-7
	Auhar	BI-3	Sirmour	Narag	SI-1
	Kuthira	BI-4		Nohra	SI-2
	Talvano	BI-5		Deothal	SI-3
Chamba	Chanad	CH-1		Dilman	SI-4
	Shahu	CH-2		Deyoltikkeri	SI-5
	Balu	CH-3		Kalaghat	SI-6
	Audhpur	CH-4		Nandel	SI-7
	Rajpura	CH-5		Dotliji	SI-8
	Saru	CH-6		Maryog	SI-9
	Rajnagar	CH-7		Seenaghat	SI-10
Hamirpur	Bharari	HA-1		Adgu	SI-11
	Patta Balakhar	HA-2		Loyankotla	SI-12
	Bassi	HA-3		Sarpadol	SI-13
	Hamirpur Kanal	HA-4		Saraha Chakli	SI-14
	Ghahar	HA-5		Madhobag	SI-15
Kangra	Dharamshala	KA-1		Nainatikker	SI-16
	Bhalun	KA-2	Solan	Gaura	SO-1
	Varal	KA-3		Nauni	SO-2
Mandi	Samaila	MA-1		Dharja	SO-3
	Bachhwan	MA-2		Deog	SO-4
	Bambla	MA-3		Badhlech	SO-5
	Tatahar	MA-4		Amberkothi	SO-6
	Sarkaghat	MA-5		Oyali	SO-7
Shimla	Daugi	SH-1		Kailar	SO-8
	Ninmun	SH-2		Deothi	SO-9
	Jeury	SH-3		Jaunaji	SO-10
	Tatapani	SH-4		Mishuar	SO-11
	Sunni	SH-5		Kasholi	SO-12

The experiment was conducted in Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan (H.P.), during the year 2008-09. (1250 amsl $30^0$51N and $76^0$11 E. The region experiences subtropical climate with moderately hot summers and cold winter. Maximum temperature often exceeds 35^0 C in May – June and minimum temperature drops to as low as 0^0 C in January. Relative humidity ranges from 40-85%, maximum during monsoon season. Frost occurrence in winter is common with 1000-1300 mm annual rainfall.

The biometric traits, *viz*., height and diameter of the trees were measured by Ravi Multimeter and Vernier caliper respectively. The leaves on new shoots of current year were counted. However, very minute leaflets were ignored. Leaf area was measured with the help of leaf area meter. Leaf fresh weight and oven dry weight was recorded and dry matter content was calculated accordingly. Total leaf biomass was also recorded for the year.

For the analysis of qualitative fodder characters, composite sample of fifty leaves was taken from four branches over different directions of each tree during November. These samples were washed and treated with 0.1N HCl followed by washing with distilled water, dried till constant weight, ground and analyzed for qualitative nutritional parameters, *viz*., Crude fiber (%), crude protein (%), ether extract (%), total ash (%) and nitrogen free extract (%) as per procedures given in AOAC (1995) and Sankaram (1966). Genetic divergence was estimated by Mahalanobis D^2 Statistics (1936) and the progenies were grouped on the basis of minimum generalized distances using Tocher's method as described by Rao (1952).

Results and Discussion

Based on morphometric and fodder parameters, the 60 open pollinated progenies of *Grewia optiva* were grouped into four clusters using non hierarchical Euclidean cluster analysis. Cluster III contained the highest number of progenies (27) and included progenies, BI-1, BI-2, BI-4, BI-5, CH-2, HA-1, HA-3, HA-4, KA-1, KA-2, KA-3, MA-1, MA-2, MA-3, MA-4, SH-1, SH-3, SH-4, SH-5, SH-6, SH-7, SI-2,SI-3, SI-8, SI-13, SO-5 and SO-9 while as Cluster IV had the minimum number progenies; eight in number, *viz*., BI-3, SH-2, SI-10, SI-14, SO-1, SO-4, SO-7, SO-12. Cluster I had 16 progenies (CH-5, CH-6, CH-7, HA-5, MA-5, SI-1, SI-4, SI-5, SI-9, SI-12, SI-16, SO-2, SO-3, SO-6, SO-10 and SO-11) and Cluster II constituted of 9 progenies (CH-1, CH-3, CH-4, HA-2, SI-6, SI-7, SI-11, SI-15 and SO-8).

Means of morphometric and fodder parameters of different progenies of *Grewia optiva* (Table 2) included in clusters recorded that maximum mean height (6.75 m), diameter (8.88 cm), leaf dry matter content (59.40%) and estimated number of current year leaves (2230.33) was recorded in Cluster IV, whereas Cluster I had maximum nitrogen free extract (43.60%) and Cluster III crude protein (21.09%). Cluster II had mean maximum values for fresh weight of leaves (81.33 g), dry weight of leaves (44.56 g), leaf area (68.10 cm^2), total green leaf biomass (1760.74 g), crude fibre (21.28%), total ash (12.31%) and ether extract (5.36%).

Average intra and inter cluster distances (D-value) for morphometric and fodder parameters among different progenies (Table 3) have shown maximum intra cluster distance in Cluster IV (2.90). The generalized intra-cluster D^2 value was 2.679, 2.880, 2.666 and 2.90 for cluster I, II, III and IV, respectively. Maximum and minimum inter cluster distance were noted between Cluster I and Cluster II (5.652) and Cluster I and Cluster III (2.551).

Since the progenies were selected from the different eco-geographical regions of the state, they showed varied differences among each other. Besides this, the genetic constitution of the species must be the cause of huge variation in these traits. Therefore, the variation observed may be due to the different genetic architecture as a result of breeding, level of heterogeneity and adaptation to diverse environmental conditions. The pattern of group constellations proved that geographical diversity need not necessarily be related to genetic diversity. This was in line with the results obtained earlier by Sehgal *et al.,* (2003) in *Grewia optiva*; Pandey *et al.,* (1995) in *Populus deltoides.* It may be suggested that though geographic diversity may not necessarily be an index of genetic diversity, due attention should be paid to geographic diversity if sufficient genetic diversity has to be accumulated in the germplasm. The divergence of these progenies regarding these morphometric and fodder traits can be analyzed from the dendrogram (Fig 2). Most divergent progenies may be crossed to obtain more heterotic vigour.

Hybridization between progenies falling in the most distant clusters (I and II; Table 3) should result in maximum hybrid vigour and eventually desirable segregates or desirable combinations leading to development of useful genetic stock. Variability and divergence studies thus suggested that variation can be exploited for any breeding programme of *Grewia optiva* on the basis of its important characteristics to obtain heterotic vigour through hybridization.

Fig.2 Dendrogram showing divergence for morphometric and fodder parameters among the different progenies of *Grewia optiva*

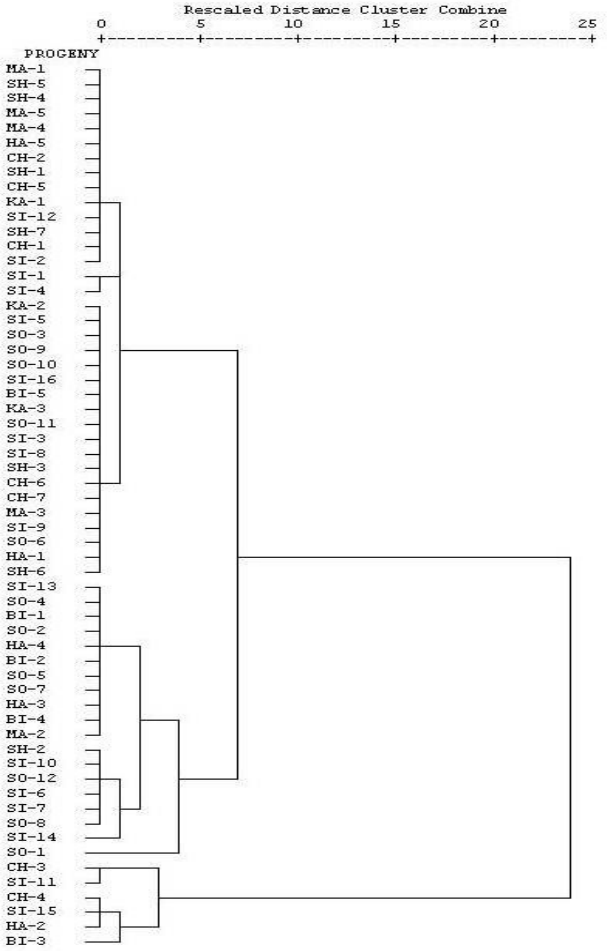

Table 2. Means of morphometric and fodder parameters of different progenies of *Grewia optiva* grouped in four clusters.

Parameter	Mean Values			
	Cluster I	Cluster II	Cluster III	Cluster IV
Height (m)	5.94	6.63	6.01	6.75
Diameter (cm)	7.31	8.42	7.60	8.88
Fresh weight of leaves (g/100)	53.55	81.33	56.30	60.85
Dry weight of 100 leaves (g)	30.03	44.56	32.25	35.98
Leaf dry matter content (%)	56.49	54.92	57.59	59.40
Leaf area(cm^2)	49.23	68.10	51.19	52.02
Estimated number of leaves (current yr)	1475.98	2221.56	1587.48	2230.33
Total green leaf biomass (g)	782.25	1760.74	876.31	1311.71
Crude protein (%)	19.49	20.51	21.09	20.30
Crude fibre (%)	19.97	21.28	20.50	19.31
Total ash (%)	12.12	12.31	11.60	11.93
Ether extract (%)	4.82	5.36	5.18	5.33
NFE (%)	43.60	40.54	41.63	43.12

Table 3. Average intra and inter cluster distances(D-value) for morphometric and fodder parameters among different progenies of *Grewia optiva*

Cluster	I	II	III	IV
I	2.679			
II	5.652	2.880		
III	2.551	4.539	2.666	
IV	3.577	4.083	3.166	2.90

Underlined distances are intra cluster distances

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