



GENETIC VARIABILITY IN SEEDLING CHARACTERISTICS OF *Bauhinia vahlii* Wight & Arn.

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Bauhinia vahlii Wight and Arn. belongs to the family Caesalpiniaceae and is commonly known as Maloo creeper or Toor. It is one of the important species whose leaves are even used as fodder and are commercially used as donas and pattals. It thrives well in the sub-Himalayan region ranging upto 1500 meters above mean sea level. The fruits (pods) were collected from different seed sources of Himachal Pradesh including four districts viz. Solan, Sirmour, Hamirpur and Kangra. Analysis of variance for different seedling characters revealed the significant variations. Highly significant correlation was found between collar diameter and other growth characters namely seedling height, internodal length and number of leaves in half-sib progenies. The genetic estimates worked out for mother tree leaf area and leaf length has shown promising possibilities for heritability (0.35) and genetic gain (10.15) respectively. The nursery growth performance of seedling height was estimated to show accountable genetic gain (16.17 %) and high heritability (0.68) for leaf length. The present study concluded that four seed source viz., Bhojnagar, Dharbanar, Kathar and Tauni Devi have most of the scalable performances on key characters like leaf foliage of half sibs as well as seedling growth potentials. These seed sources could further be evaluated at field conditions for effective selection of superior mother trees for further breeding programmes.

Key words: *Bauhinia vahlii*, correlation, genetic gain, heritability, pod

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INTRODUCTION

Bauhinia vahlii Wight & Arn. is one of the important species whose leaves are even used as fodder and commercially used as donas and pattals. It belongs to the family Caesalpiniaceae and is commonly known as Maloo creeper or Toor. The species' main stem is characterized by hard, solid and cylindrical woody liana with thick brown cork showing longitudinal fissures and transverse cracks. It grows obliquely, vertically or horizontally for about a few meters length and may continue horizontally, later taking the support on the nearby woody species and trees. The branching is monopodial and it bears the pairs of revolute tendrils, petioles, leaves and/or inflorescences. The leaves appear on trees as an evergreen look; the new leaves start appearing during the month of March, followed by the terminal raceme. The species is well established as medicinal woody climber and its various parts have medicinal uses such as leaves are used as demulcent, edible seed as tonic, bark for extracting tannins and leaves are even used as fodder and commercially used as donas and pattals (AGARWAL, 2003). *Bauhinia vahlii* Wight and Arn., an economically important species known for its bigger papery bilobed suitably used as eating plates, also contains phenolic compounds such as flavonoids, phenolics acid and tannins possess diverse biological activities including anti-inflammatory, and anti-carcinogenic activities (SOWNDHARARAJAN and KANG, 2013); flavonoid, betulinic acid, triterpene, campesterol and benzenoid (NARAYAN et al. 2012). In seed source trials, the seeds collected from different sources under varying climatic conditions are compared to assess the genotypical and phenotypical characteristics of the seed.

Seed source trials are the first step for the conservation of forest tree species so that the germplasm should be properly collected, maintained and conserved (KEDARNATH, 1982). Being considered as a preliminary step of survey, screening and selection for carrying out the breeding programme, it provides basic knowledge of both genetic and environmental variations which allow comparisons among seed sources on the basis of various characters viz., seed size, seed weight, seedling height and collar diameter. Variations are necessary for adaptation and improvement, and the amount of variation determines the ability for breeding programmes to improve species (NAMKOONG, 1984). Any tree improvement programme begins with a field survey and selection, followed by the delimitation of seed sources capable of producing the best adapted trees. Knowledge of nature and magnitude of variability before starting any selection programme are helpful in carrying out a successful breeding programme. Thus, determining genetic variability and partitioning the observed variability with the help of suitable genetic parameters such as phenotypic variance, genotypic variance, heritability etc. is essential for understanding the genetic nature of traits. The heritability of the traits determines the extent of its transmission from one generation to the next (SABU et al., 2009).

MATERIAL AND METHODS

Present investigation was carried out at field area under the Department of Tree Improvement and Genetic Resources, College of Forestry, Dr. Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh situated at 30.8593 N Latitude and 77.1773 E Longitude during 2019-2020. The extent of seed sources of *Bauhinia vahlii* Wight and Arn. under study, encompassing ten seed sources, stretched from sub-Himalayan regions ranged from latitude 30.891° N to 32.4451° N and longitude 75.8912° E to

77.1746°E (Table 1). These ten seed sources (district) selected were Nurpur (Kangra), Dunera (Kangra), Ramshahar (Solan), Rangas (Hamirpur), Balduk (Hamirpur), Kuthar (Solan), Tauni devi (Hamirpur), Kathar (Sirmour), Dharbanar (Solan) and Bhojnagar (Solan). A minimum of 500 m tree to tree distance was maintained to avoid genetic hinderance by pollen mixture. Considering each mother tree as a replication, fifteen seeds per mother tree per seed source (total 45 seeds) were sown in 5x7 inch polybags. Completely Randomized Block Design was deployed for this experiment. After one year, these seedlings were evaluated for various morphological parameters viz., seedling height, collar diameter, internodal length, number of branches, number of leaves, leaf length and leaf breadth. Three trees per seed source were selected for seed collection.

Table 1. Selected seed sources for nursery parameters.

Seed source	District	Altitude m (a.m.s.l)	Latitude	Longitude
Nurpur	Kangra	478	32.1458° N	76.0115°E
Dunera	Kangra	550	32.4451° N	75.8912°E
Ramshahar	Solan	815	31.0892° N	76.7957°E
Rangas	Hamirpur	890	31.7112° N	76.4632°E
Balduk	Hamirpur	900	31.6908° N	76.5177°E
Kuthar	Solan	1065	30.9731° N	76.9672°E
Tauni Devi	Hamirpur	1189	31.7144° N	76.5972°E
Kathar	Sirmour	1480	30.7667° N	77.1442°E
Dharbanar	Solan	1500	30.8294° N	77.0748°E
Bhojnagar	Solan	1502	30.8910° N	77.1746°E

Statistical analysis

The data thus obtained was subjected to statistical analysis as described by PANSE and SUKHTAME (1967). The Statistical analysis for each parameter was carried out on mean values and the analysis of variance (ANOVA). Phenotypic coefficient of variability (PCV) and genotypic coefficient of variability (GCV) were estimated as per formula given by BURTON and DEVANE (1953). Heritability in broad sense was calculated as per formula given by BURTON and DEVANE (1953) and ALLARD (1960). The genetic advance was worked out as suggested by LUSH (1940) and further used by BURTON and DE-VANE (1953) and JOHNSON *et al.*, (1955). Genetic advance expressed as per cent of population mean was suggested by JOHNSON *et al.*, (1955).

Simple correlation between all characters under study was estimated as per the method described by ROBINSON et al. (1951) and SEARLE (1961). The data analysis was done using SPSS software (2006).

RESULTS AND DISCUSSIONS

Nursery performances of half sibs

Within these growing limits, a lot of variation was observed among seed sources. The seeds of *Bauhinia vahlii* were cleaned, graded and sown in polybags in three replication under glass house conditions for nursery parameters. The maximum number of leaves in the seedlings was recorded from Bhojnagar seed source. The results of the study are consistent with the results of the work by IRENGBAM and THAPLIYAL (2016) who studied seedling growth parameters in *Bauhinia purpurea* L. Results computed in Table 2 depicted that the maximum numbers of branches were recorded from Balduk seed sources with the mean value of 0.66. The internodal length per seedlings was measured. The observation was taken for one-year old seedlings after the end of germination. The maximum internodal length was recorded from Bhojnagar seed source with the mean value of 6.26 cm.

The seedling height of one year raised nursery was recorded to be 34.96 cm for Kathar seed sources. Seedlings raised in the glass house were observed to record the diameter attained by them at age of one year. The maximum collar diameter was recorded in the Bhojnagar seed source with the mean value of 9.29 mm. The leaf length of half sibs was recorded to be maximum in Bhojnagar seed source with the mean value of 24.6 cm. The leaf breadth of the seedlings was recorded at the age of one year. Tauni Devi seed source was observed to record the maximum leaf breadth with the mean value of 10.47 cm. Seed source variations in morphological characteristics are in accordance with the findings of THAKUR (2009).

Table 2. Variation in nursery performance at the age of twelve months.

Seed sources	Seedling height (cm)	Collar diameter (mm)	Internodal length (cm)	Number of branches	Number of leaves per branch	Leaf length (cm)	Leaf breadth (cm)
Nurpur	29.21	6.85	4.63	0.58	6.24	20.31	6.63
Dunera	27.74	6.25	4.51	0.59	5.23	19.83	8.30
Ramshahar	25.36	7.34	6.16	0.56	6.50	18.27	8.73
Rangas	25.52	6.70	4.88	0.60	6.65	21.30	9.23
Balduk	26.45	7.62	5.00	0.66	6.78	20.87	8.27
Kuthar	28.86	6.75	6.23	0.58	6.87	18.69	8.30
Tauni Devi	29.49	7.99	6.18	0.55	6.65	19.51	10.47
Kathar	34.96	8.63	6.13	0.61	7.71	22.33	9.90
Dharbanar	31.53	8.04	6.04	0.65	7.63	23.70	8.50
Bhojnagar	34.87	9.29	6.26	0.29	8.70	24.67	8.33
Overall mean	29.3	7.54	5.60	0.56	6.89	20.9	8.60
CD _{0.05}	4.71	1.32	1.22	NS	NS	2.26	NS

Genetic estimates

Genetic estimation is an important tool for evaluating data obtained from mother trees of different genotypes and half sib progenies after statistical analysis. Heritability, genetic gain and genetic advance are the major genetic parameters in tree improvement work.

GCV and PCV are categorized as low (<10 %), moderate (10-20 %) and high (>20 %) as categorized by SIVASUBRAMANIAN and MADHAVAMENON (1973). Among the nursery stage parameters (Table 3), moderate GCV was recorded for collar diameter (11.19 %) followed by internodal length (11.07 %) and seedling height (10.50 %), whereas the lowest GCV was recorded for number of leaf (5.46 %) followed by number of branches (7.80 %), leaf breadth (9.20 %) and leaf length (9.32 %). The highest PCV was recorded for number of branches (30.0 %), whereas the moderate PCV was recorded for number of leaf (18.50 %), followed by internodal length (16.83 %), leaf breadth (16.28 %), collar diameter (15.16 %), seedling height (14.06 %) and leaf length (11.24 %).

Among the nursery stage parameters, the highest heritability was recorded for leaf length (0.68), highest genetic advance was recorded for seedling height (4.75) whereas highest genetic gain was recorded for collar diameter (17.01). The results are at par with the findings of NAGGAR (2006) working in variation study in *Bauhinia variegata*.

Table 3. Genetic estimates for half sibs in the nursery stage.

Nursery characters	Mean	Range	GCV	PCV	Heritability (broad sense)	Genetic advance	Genetic gain
Seedling height	29.3	25.36-34.96	10.50	14.06	0.55	4.75	16.17
Collar diameter	7.54	6.25-9.29	11.19	15.16	0.54	1.28	17.01
Internodal length	5.60	4.51-6.26	11.07	16.83	0.43	0.84	15.01
Number of leaf	6.89	5.23-8.70	5.46	18.50	0.31	0.82	11.94
Number of branches	0.56	0.29-0.66	7.80	30.0	0.06	0.23	4.18
Leaf Length	20.9	18.27-24.67	9.32	11.24	0.68	3.33	15.91
Leaf Breadth	8.60	6.63-10.47	9.20	16.28	0.31	0.92	10.72

Correlation coefficient

Correlation is an important tool to measure the level of association between various characters. It plays an important role in tree improvement program as it helps in understanding the association among different characters whether one character is associated with the other character or not.

Collar diameter shows highly significant positive correlation with seedling height ($r=0.77$), number of leaves ($r=0.89$), number of branches ($r=0.52$) and shows significance at 1% level for internodal length ($r=0.66$) and leaf length ($r=0.70$). Seedling height showed highly significant correlation with collar diameter which is in confirmation with BHAT and CHAUHAN (2002) in *Albizia lebbek*.

Seedling height shows significant positive correlation with number of leaves ($r= 0.74$) which is in confirmation with ANAND and DWIVEDI (2014) in *Bauhinia variegata* whereas significance at 1% level ($r= 0.713$) exist between seedling height and leaf length (Table 4). Internodal length ($r=0.67$) shows significant positive correlation with the number of leaves.

Table 4. Simple correlation coefficient for nursery parameters.

TRAITS	NOL	NOB	INL	PH	CD	LL	LB
NOL	1.000						
NOB	-0.529	1.000					
INL	0.678*	-0.356	1.000				
PH	0.740*	-0.471	0.495	1.000			
CD	0.890**	-0.530	0.663*	0.779**	1.000		
LL	0.764*	-0.389	0.163	0.713*	0.702*	1.000	
LB	0.189	-0.045	0.490	0.145	0.349	-0.001	1.000

** = Highly significant at 1 % level

* = Significant at 5 % level

Where, NOL = number of leaves per branch, NOB = number of branches, INL = internodal length, PH = plant height, CD = collar diameter, LL = leaf length, LB = leaf breadth

CONCLUSION

The present investigations were carried out in Himachal Pradesh on the evaluation of Toor (*Bauhinia vahlii*) seed sources. Being an economically and ecologically important but under-improved multipurpose forest species, the quantification of natural, morphological and genetic variations at the nursery stage, enables early identification of superior seed sources along with key selection traits contributing to variations. The current study's findings include that the juvenile growth evaluated through one year old seedling height and collar diameter depicted the superiority of seed sources namely Bhojnagar, Dharbanar of district Solan and Tauni Devi of district Hamirpur for selection purposes. Thus, the present study concluded that four seed source viz., Bhojnagar, Dharbanar, Kathar and Tauni Devi have most of the scalable performances on key character like leaf foliage of half sibs and seedling growth potentials; interwoven with promising estimates for establishing genetic basis for further tree improvement work.

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GENETIČKA VARIJABILNOST OSOBINA KLIJANACA *Bauhinia vahlii* Wight & Arn.

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Izvod

Bauhinia vahlii Wight i Arn. pripadaja familiji Caesalpiniaceae i opšte je špoznata kao puzavica Maloo ili Toor. Ona je ejdna od važnih vrsta čiji se listovi koriste kao stočna hrana, a komercijalno se koristi kao donas i pattals. Dobro uspeva u sub-himalajnom regionu do 1500 metara iznad nivoa mora. Plodovi (mahune) su skupljeni iz različitih izvora semena sa Himachal Pradesh uključujući četiri distrinkta Solan, Sirmour, Hamirpur i Kangra. Analiza varijanse za različita svojstva sadnica je pokazala značajno variranje. Visoko značajna korelacija je nađena između prečnika i drugih svostva rasta kao što su dužina klijanaca, dužina internodija i broj listova u potomstvu polusrodnika. Geentičke procene za lisnu površinu majčinskog stabla i dužinu lista su pokazale obećavajući mogućnost za heritabilnost (0.35) i genetičku dobit (10.15). Procenjeno je da performanse rasta sadnica u rasadniku pokazuju merljivu genetičku dobit (16.17 %) i visoku heritabilnost (0.68) za dužinu lista. Ova studija je zaključila da četiri izvora semena Bhojnagar, Dharbanar, Kathar i Tauni Devi imaju većinu merljivih performansi za ključna svojstava kao što je lišće polusrodnikakao i potencijal rasta sadnica. Ovi izvori semena mogu dalje da se ispituju u poljskim uslovim za efikasniju selekciju superiornijih majčinskih stabala za buduće programe selekcije.

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