PHENOTYPIC VARIATION AND SEED CHARACTERS EVALUATION IN DIFFERENT PROVENANCES OF *ALBIZIA LEBBECK* (L.) BENTH.

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ABSTRACT: The present investigation on *Albizia lebbeck* (L.) Benth. was carried out to estimate the genetic variability for some phenotypic characters and seed traits of trees selected from fifteen different provenances. Analysis of variance showed significant differences for all the characters viz; tree height, diameter, crown spread, seed length, seed width and 100 seed weight. Phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV) and estimates of genetic parameters viz; heritability, genetic advance and genetic gain have also been discussed.

INTRODUCTION

The large scale afforestation programme in our country will demand a large amount of planting material and it is necessary to start with superior planting material to make those plantations more productive both qualitatively and quantitatively. This necessitates effective and planned tree breeding programme to capture maximum genetic gain from the natural population. The most successful tree improvement programmes are those in which proper provenance or provenances are used (Zobel and Talbert, 1984).

For a successful promotion of large scale plantation there is a need of carefully planned and well directed provenance research (Sehgal and Chauhan, 1995). The most successful tree improvement programme is that in which proper seed sources and provenances are used. The loss from using the wrong sources can be great and even disastrous (Zobel and Talbert, 1984). Potential and importance of assessing genetic differences associated with place of origin have long been realised on a global scale and several national and international provenance trials have been initiated.

Albizia lebbeck (L.) Benth. is a member of sub-family Mimosoidae of family Fabaceae. It is commonly known as East Indian Walnut, Kokko, Siris etc. It grows wild in the sub - Himalayan region, West Bengal, Chota Nagpur, Indian peninsula, Tamil Nadu, Kerala and Andaman Island. It occurs up to an elevation of about 1500m. It is a tree of tropical and sub-tropical climate where the summer are hot and winter are generally mild except in the sub-Himalayan track . It is a tree of mixed deciduous forest both dry and moist type or of moist evergreen or evergreen forest (Singh, 1982).

It is a multipurpose tree species suitable for afforestation on a wide range of site conditions and good fuelwood. Even though it grows on wide variety of soil conditions it prefers moist localities (Troup, 1921). The species improves the soil fertility through nodulation and it has been widely planted as avenue tree and in garden also. It is now found growing almost throughout the country except in the temperate Himalayan region. *Albizia lebbeck* is a strong light demander and require complete overhead light for its optimum growth. The bark contain tannin and some saponin. The leaves and twigs are widely used as fodder and for manuring purpose (Singh, 1982). It has also been reported to be good Agroforestry tree species (Nair, 1993). A reddish brown gum is obtained from crack in the bark (Ramprakash, 1991). Seeds are astringent and given in piles and restorative tonic, roots powdered in making strong gums, leaves in night blindness (Singh, 1995). It is reported to be a good fodder tree species and its wood is used for furniture, carving, cabinet work, panelling and wheel work. There is a good potential of using selected superior genotypes of species in afforestation and reforestation programme. Presently only seed propagated plantations are largely available in our

country. However, in recent times under Social Forestry and Agroforestry Schemes there has been an effort to raise Siris plantation in both private and government lands. This is possible only if seed material from several provenances is assessed. Hence there is greater emphasis to identify the best provenances of Siris. Therefore, the present studies were undertaken to know the phenotypic variations among different trees / provenances as also seed characteristics to select the best provenance for further breeding programme.

MATERIALS AND METHODS

The present study was carried out during the year 2011-12 in the Department of Tree Improvement & Genetic Resources, Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh. A survey was conducted along with species distribution ranges and fifteen edapho-climatically different and geographically isolated provenances were selected from different locations of the state (Table-1). These locations were coded as P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14 and P15, respectively. Five superior trees were selected at each location on the basis of different morphological traits viz; height, diameter, crown spread and freedom from insect pest attack and diseases. The trees thus selected were marked with durable yellow paint. Seeds from mature pods were collected separately from these selected trees and processed for further use.

Table-1: List of selected provenances

Code no	Provenance	District	Altitude (m)
(P1)	Bilaspur	Bilaspur	502
(P2)	Dadhol	Bilaspur	700
(P3)	Bhota	Hamirpur	805
(P4)	Rangus	Hamirpur	480
(P5)	Dehri	Kangra	1002
(P6)	Jachh	Kangra	880
(P7)	Khatiyad	Kangra	900
(P8)	Jogipanga	Una	380
(P9)	Mubarakpur	Una	400
(P10)	Khatiyadi	Una	340
(P11)	Dhaulakuna	Sirmaur	345
(P12)	Shambuwala	Sirmaur	322
(P13)	Kunihar	Solan	850
(P14)	Kakkadhatti	Solan	900
(P15)	Nauni	Solan	1204

The data were recorded on the characters viz; tree height (m), tree diameter (cm), crown spread (m), seed length (mm), seed width (mm) and 100 seed weight (g). The data were analyzed statistically using RBD for the assessment of analysis of variance as suggested by Panse and Sukhatme (1967). Coefficient of variability, heritability, genetic advance and genetic gain were calculated by the formula used by Burton and Devane (1953) and Johnson *et al* (1955).

RESULTS AND DISCUSSION

The population extended to sub-tropical foot hills of different districts of Himachal Pradesh. Within these growing limits fifteen well distributed provenances of *Albizia lebbeck* were selected. A lot of variation was observed among the different trees selected at various provenances for the phenotypic traits (Table-2).

Perusal of the table revealed that the maximum tree height was observed for P11 with the mean value of 23.4 m succeeded by P13 and P9 with the mean values of 19.60 m and 19.40 m, respectively. The minimum value (13.0 m) was recorded for P2 preceded by P12 and P4 with the mean values of 14.8 m. The appraisal of Table-2 illustrated that

Table-2: Phenotypic variation among different provenances of *Albizia lebbeck*.

Provenance	Tree height (m)	Tree diameter (cm)	Crown spread (m)
Bilaspur	16.20	22.48	5.04
Dadhol	13.00	15.28	4.69
Bhota	16.20	23.22	3.80
Rangus	14.80	14.33	2.50
Dehri	17.40	21.46	3.39
Jachh	17.40	21.97	1.85
Khatiyad	15.80	19.17	3.06
Jogipanga	17.80	18.99	4.89
Mubarakpur	19.40	21.65	5.45
Khatiyadi	16.80	22.90	4.29
Dhaulakuna	23.40	22.80	4.34
Shambuwala	14.80	23.14	4.30
Kunihar	19.60	22.58	4.63
Kakkadhatti	17.40	15.22	4.20
Nauni	18.00	18.15	4.65
CD(0.05)	2.96	2.32	1.75

the highest tree diameter was found for P3 with the mean value of 29.41 cm followed by P12 and P10 with the mean values of 29.03 cm and 28.98 cm and were found statistically at par with each other. The lowest value was found for P4 with the mean value of 14.33 cm. As far as crown spread is concerned it was found maximum for P9 with the value of 5.45 m followed by P1 and P8 with the mean values of 5.04 m and 4.89 m, respectively which were found statistically at par with each other. The lowest value (1.85 m) was recorded for P6.

Perusal of Table-3 revealed the maximum seed length for P6 with mean value of 9.91 mm followed by P1 and P4 with mean values of 9.58 mm and 9.49 mm, respectively which were found statistically at par with each other. The minimum value was recorded for P12 with mean value of 8.36 mm. The highest seed width was recorded for P13 with the value of 8.43mm followed by P6 and P3 with the mean values of 7.95 mm and 7.86 mm. The lowest value (6.82 mm) was observed for P14. Data presented in the table indicated the highest value (14.42 g) for 100 seed weight in P6 followed by P10 and P1 with the mean values of 13.46 g and 13.34 g and were statistically at par with each other. The minimum value was (8.13 g) projected by P15.

Table–3: Variation in seed traits among different provenances of *Albizia lebbeck*

Provenance	Seed length (mm)	Seed width (mm)	100 seed weight (g)
Bilaspur (P1)	9.58	7.80	13.34
Dadhol (P2)	8.36	7.21	10.87
Bhota (P3)	8.85	7.86	10.63
Rangus (P4)	9.49	6.97	12.21
Dehri (P5)	9.34	6.97	10.23
Jachh (P6)	9.91	7.95	14.42
Khatiyad (P7)	9.11	7.51	11.22
Jogipanga (P8)	8.96	7.69	11.16
Mubarakpur (P9)	9.04	6.94	9.78
Khatiyadi (P10)	9.60	7.50	13.46
Dhaulakuna (P11)	8.43	6.88	9.31
Shambuwala (P12)	8.40	7.00	8.53
Kunihar (P13)	8.53	8.43	9.05
Kakkadhatti (P14)	8.73	6.82	9.53
Nauni (P15)	8.42	6.94	8.13
CD(0.05)	0.86	0.71	2.28

Variation study is a pre-requisite for genetic upliftment of any tree species. They are of paramount importance for developing effective tree improvement strategies (Sharma *et al.*, 1994). Desired genetic improvement cannot be achieved unless the variation of interest is properly understood. The assessment of natural variation with regard to commercially important traits is of prime consideration (Dogra, 1992). Due to wide geographical distribution of *Albizia lebbeck* there is a considerable scope for its study on morphological and physiological variations.

In the present study the difference among provenances for tree height ranged from 13.0 m to 23.40 m with the mean value of 17.2 m. Tree height which is considered to be an important trait for selection showed that trees selected at P11(Dhaulakuan) were superior as compared to trees at other locations. The diameters of trees depicted higher mean value (23.22 cm) for P3 (Bhota) provenance followed by P12 (Shambuwala). With respect to crown spread trees selected from P9 (Mubarakpur) provenance maintain their superiority over all the other selected provenances. Similar variations among different provenances and seed sources with respect to morphological traits has also been reported by several workers in many species.

Wide range of variations were reported amongst different provenances for growth characteristics in wild pomegranate growing in different areas of Himachal Pradesh by Pant, 1995 and Bhrot, 1998. Luna *et al.* (2006) observed similar variations for different phenotypic characters among 20 seed sources of *Albizia lebbeck*. Tej Prakash (2011) studied variations on tree height, diameter and crown spread among different seed sources of *Acacia catechu* and found considerable variations.

In this study different provenances varied significantly with respect to seed traits *viz.* seed length, width and 100 seed weight. The variations among provenances for seed traits offers ample scope for improvement. It was also seen that variations observed for seed traits did not follow any particular trend with regard to different provenances. This could be probably because of environmental

factors which might have played a role in changing any component of seed as also reported by Todaria *et al.*, 2003.

Maximum seed length (9.91 mm) was observed in P6 (Jachh) and minimum (8.36 mm) in P12 (Shambuwala). Maximum seed width (7.95 mm) was found in P6 (Jachh) and minimum (6.82 mm) in P14 (Kakkadhatti). Hundred seed weight was recorded to be maximum (14.42 g) in P6 (Jachh) and minimum (8.13 g) in P15 (Nauni). Outcome of these results suggests that seeds with larger size (length and width) possessed higher weight. Provenances showing maximum values for different seed characters could be considered for use in afforestation programme and further breeding work since the superiority might be because of genetic potential of these provenances Similar variations have also been reported by different workers in various species. The result findings are supported by the studies of Bhatt, 1999; Todaria *et al.*, 2003, Neelanwar *et al.*, 2009 and Hooda *et al.*, 2009.

Estimates of Variability and Genetic Parameters

Significant variations were observed among different provenances with regard to the phenotypic characters. Therefore, the data for the different provenances were pooled for the calculation of variability estimates and genetic parameters for different characters.

Variability was estimated in terms of coefficients of variability (phenotypic and genotypic). Genetic parameters were worked out in terms of heritability (broad sense), genetic advance and genetic gain. Table-4 depicted the highest phenotypic coefficient of variability for tree diameter (80.22 %), while lowest value was recorded for tree height (77.46 %) . The genotypic coefficient of variation was found highest for the tree diameter (69.12 %), whereas the minimum value was shown by tree height (53.21 %). As far as heritability is concerned it was observed maximum (74.25 %) for tree diameter, while the minimum was recorded for crown spread (23.90 %). The genetic advance was found maximum (5.53) for tree diameter and the minimum for crown spread (0.78). The genetic gain was observed maximum for tree diameter (27.27%) while minimum was found for tree height (18.14 %).

Among seed traits phenotypic coefficient of variability was recorded maximum (75.31%) for 100 seed weight whereas minimum value was observed for seed width (25.28 %). Maximum genotypic coefficient of variability again was recorded for 100 seed weight (51.75 %), whereas minimum value was recorded for seed length (13.76%)

Maximum heritability value (47.0%) was recorded for 100 seed weight followed by seed width (36.0%). Seed length recorded low heritability having value of 26.0 %.

As far as genetic advance is concerned maximum value of 2.41 was recorded for 100 seed weight followed by seed width (0.53). Minimum genetic advance was recorded for seed length with the value of 0.44. Genetic gain also depicted similar pattern as that of heritability with higher value of 22.34 % for 100 seed weight followed by seed width (7.19 %) and lowest value (4.90%) was recorded for seed length.

Critical observations for tree height, diameter and crown spread from Table-4 showed moderate genotypic coefficient of variability, high heritability with a moderate genetic gain. This indicated that

Table-4: Genetic estimates of various phenotypic and seed characters of trees among different provenance

Trait	Coefficient of variability (%)		Heritability (%)	Genetic advance	Genetic gain (%)
	Phenotypic	Genotypic			
Tree height (m)	77.46	53.21	47.19	3.12	18.14
Tree diameter (cm)	80.22	69.12	74.25	5.53	27.27
Crown spread (m)	78.53	38.4	23.9	0.78	19.16
Seed length (mm)	26.49	13.76	26.98	0.44	4.90
Seed width (mm)	25.78	15.63	36.73	0.53	7.19
100 seed weight (g)	75.31	51.75	47.22	2.41	22.34

these traits are under additive genetic control which is responsible for the phenotypic expression of these traits. Therefore, these characters may be considered effective for selection. These results are in conformity with the studies of Pant (1995) and Bhrot (1998) in *Punica granatum*, Luna *et al.* (2006) in *Albizia lebbeck* .

Johnson *et al.* (1955) explained that provenance heritability does not indicate the amount of genetic improvement that can be achieved through provenance selection. Therefore, it has been suggested that high heritability coupled with high genetic gain is the true index for effective selection (Johnson *et al.*, 1955 and Swarup and Chaugale, 1962). High provenance heritability was not associated with high genetic advance in most of the cases which is very much in agreement with the observations of Swarup and Chaugale (1962). The provenance heritability estimated for any character is useful when high selection gain in that character is also feasible (Kaul and Bahu, 1974).

The critical examination of variability estimates illustrated in Table-4 revealed that seed length and seed width projected low GCV, a low heritability with low genetic gain. However, 100 seed weight expressed moderate GCV, moderate heritability with moderate genetic gain which implies that simple selection criteria alone will not work for these characters. The low heritability for these traits implies the influence of environmental conditions of respective provenances distributed over different geographical areas and experiences varied kinds of edaphic and climatic conditions. Hence, variability cannot be attributed only as genetic or environmental but may include environmental interactions also. These results are in line with the findings of Gera *et al* 2004 and Todaria *et al.*, 2004 in different species.

CONCLUSION

In the present study wide variations were observed for phenotypic traits of trees as also seed traits among the different provenances of the species which offers ample scope for exploitation of variation and improvement. However, it was also seen that variations observed for seed traits did not follow any particular trend with regard to different provenances.

REFERENCES

Bhat, G.S. (1999). *Provenance variations in seed and seedling traits of Albizia lebbeck* Benth. M.Sc. Thesis, Dr. Y S Parmar Universisty of Horticulture and Forestry, Nauni-Solan.

Bhrot, N.P. (1998). *Genetic analysis of wild Pomegranate (Punica granatum) for some growth, ecological and quality characters*. Ph.D. Thesis, Dr. Y S Parmar Universisty of Horticulture and Forestry, Nauni-Solan.

Burton, G. W. and De Vane, E.W. (1953). Estimating heritability in tall Fescue *(Festuca aruandinacea)* from replicated clonal material. *Agron. J.* **1:** 78-81.

Johnson, H.W., Robinson, H.F. and Comstock, R. E. (1955). Estimates of genetic and environmental variability in Soybeans. *Agron. J.*, **47**: 314-318.

Dogra, P.D. (1992). Priorities in forest tree genetics: unrealized tree important and breeding potential in Indian forestry. In: *Status of Indian Forestry Problems and Perspectives* (Ed. P.K. Khosla) ISTS, Solan.

Gera, Mohit, Gera, Neelu and Ginwal, H.S. (2004). Seed source variation in germination and early growth among seven indigenous populations of *Derris indica* (L) Pierre. *Ann. For.*, **12**(1): 149-154.

Hooda, M.S., Dhillon R.S., Dhanda, S. and Kumari, S. (2009). Genetic divergence studies in plus trees of *Pongamia pinnata* (Karanj). *Ind. For.* **135**(8): 1069-1080.

Kaul, M.L.H. and Bahu, A.K. (1974). Studies on some genetic parameters of rice. *Theor. l App. Gen.*. **44**: 178-183.

Luna R.K., Ntiyal S and Kumar, Rakesh. (2006). Seed source variation in Black Siris (*Albizia lebbeck* Benth. *Indian For.*, **132**(2): 149-155.

Nair, P.K.R. (1993). *An Introduction to Agroforestry*. Kluwer Academic Publishers Dordrecht, The Netherlands.

Neelannvar, T.N and Chavan, Manjunath (2009). Seed source variation in seed quality parameters of *Albizia lebbeck* (L.) Benth. *Ann. For.*, **17**(1): 14-20.

Panse, V.J. and Sukhatme P.V. (1967). *Statistical Methods for Agricultural* Workers, New Delhi: ICAR.

Pant, K.S. (1995). *Variation Studies and Provenance Evaluation of Wild Pomegranate (Punica granatum)* Ph.D. Thesis, Dr. Y S Parmar Universisty of Horticulture and Forestry, Nauni-Solan.

Ramprakash, (1991), *Propagation and Practices of Important Indian trees*. Published by International Book Distributers, Dehradun.

Sehgal, R.N. and Chauhan, K.C. (1995). Genetic improvement research on *Pinus roxburghii* in the last two decades. *Indian J. For.,* **18**(2): 107-114.

Sharma, N.K.K. Verma, U., Tiwari, J.C., Bohra M.D. and Harsh L N. (1994). Variability studies in pod and seed characteristics of *Prosopis juliflora. Indian J. For.,* (2): 161-165.

Singh, R.V. (1982). *Fodder Trees of India*, Oxford and IBH Publication Company, New Delhi.

Singh, S.P. (1995). *Favorite Agroforestry Trees*. Published by Agrotech Publishing Academy, Udaipur.

Swarup V. and Chaugale, D.S. (1962). Studies on genetic variability in Sorghum I. phenotypic variation and its heritability components in some important characters contributing towards yield. *Indian J. Gen. Pl. Breed.* **22**: 31-36.

Tej Prakash (2011). *Variation Studies in Acacia catechu* Willd. M.Sc. Thesis, Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan.

Todaria, N.P., Chhan, Shashi and Sachan, M.S. (2003). Variability studies in *Albizia lebbeck* from Garhwal Himalaya. *Rang. Manag. Agrof.*, **24**(1): 35-37.

Todaria, N.P., Shashi Chhan, Sachan, M.S. and Singh, Bhupendra (2004). Seed source variation in relation to morphophysiology of *Quercus leucotrichophora* in Garhwal Himalaya. *Indian J. Trop. Biodiver.,* **11**(1/2): 22-27.

Troup, R.S. (1921). *The Silviculture of Indian Trees.* **4** Clarendon Press Oxford, 94 p.

Zobel, B. and Talbert, J. (1984). *Applied Forest Tree Improvement*, John Wiley and Sons, New York.