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Variation in Seed and Seedling Characters of *Albizzia procera* with in Various Provenances of Chhattisgarh, India

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Abstract: ***Albizzia procera is an important agroforestry tree species widely distributed across different agricultural systems of India. More than 20 provenances of Albizzia procera in Chhattisgarh all having differences in seed, germination and seedling growth characters. Therefore to understand about the seed morphology, germination and seedling growth of some provenances is an important step in helping identification of suitable provenance for establishment in Chhattisgarh. The present study describes the variation in the seed and seedling characteristics of Albizzia procera in five provenances viz., Bilaspur, Bastar, Korba, Raigarh and Sarguja of Chhattisgarh, India. Across five provenances Bilaspur, Bastar and Sarguja showed maximum seed length, seed weight, pod length and pod weight. where as in contrast these values were found lowest in Korba provenances. The Bilaspur and Bastar provenance were regarded as the best provenances in terms of germination and seedling growth characters among all the provenances. This study ensure that the identification potential of seed sources of Albizzia procera for future afforestation and agroforestry systems.***

Keywords: *Albizzia procera*, provenance, germination and correlation

1. Introduction

Albizzia procera is commonly found on alluvial ground along streams, and in moist even swampy places. It is particularly common in low lying moist Savannahs. The species is found in the sub-Himalayan tracts from Yamuna eastwards to West Bengal, Satpura range, Gujarat, South India and in the Andamans. It has good adaptability for growing in moist as well as fairly drought conditions. Because of its wide distributional range with varying geographic, climatic and edaphic conditions and its long evolutionary history, a large variation within and among species is likely to occur, which may be reflected in the genetic constitution of its diverse populations. The significance of provenances/seed source variation studies in tree improvement is well recognized (Callaham 1964, Wright 1976, Suri 1984). These studies are necessary for scanning the available genetic variation, to utilize the best material for obtaining maximum productivity for further breeding work (Shiv Kumar & Banerjee 1986) and also help in analyzing and comparing superior characters which have great importance in breeding and/or tree improvement programmes besides preserving these variations intact for future research programme (Devgiri 1997). Variations in seed morphological characteristics, germination and seedling growth among provenances have been reported for many forest trees including Faidherbia albida (Dangasuk et al., 1997). Variation among the provenances might be attributed to genetic differences caused by the adaptation of different provenances to diverse environmental conditions (Ginwal et al., 2005) and soil types (Elmagboul et al., 2014).

The success of the tree improvement programmes depends upon the determination of amount, type and cause of genetic variability within a species. Proper planning and designing of provenance research enables quick and economical use of those provenances, which yield well adapted and productive forests. Provenance testing is essential to screen the naturally available genetic variation and to choose the best available type for further developing effective tree improvement and breeding work. For any tree improvement programme, it is essential to obtain information about the best provenance for the given site. Thus the objective of this study was to evaluate the variation existing in different provenances of *Albizzia procera* based on seed morphological, germination and early seedling growth characteristics, so as to obtain the most suitable provenances for the production of quality seedlings (planting materials) for mass afforestation and agroforestry systems.

2. Materials and Methods

The fully mature seeds were collected from the five provenances of Chhattisgarh, India(Geographical Location: Table:1). The air dried seeds with a moisture content of 7.660 ± 0.84% . To determine the variability in seed and pod morphological characters, seed length, seed width, seed thickness ,seed weight, pod length, pod width, pod thickness ,pod weight were measured for each provenance. A total of 150 seeds per provenance were randomly selected (3 replicates of 50 seeds) and organized in a completely randomized design (CRD) for measuring each morphological character (that is, 50 x 3 x 5 = 750 experimental units). Measurement was made on individual seed using a vernier caliper for seed & pod length, seed & pod width and seed& pod thickness and an electronic weighing balance for seed and pod weight.

Table 1: Geographic Location of pod /seed collection of *Albizzia procera* in Chhattisgarh

Provenance	Latitude (N)	Longitude (E)	Altitude (m)
Bilaspur	$21^0 47^l$	$81^0 14^l$	265
Bastar	$19^o.10^l$	$81^o.95^l$	552
Korba	$22^0.35^l$	$82^o.68^l$	252
Raigarh	$21^0.9^l$	$83^o.4^l$	219
sarguja	$22^o.5^l$	$82^o.5^l$	611

Hundred seeds were used for each provenance. Each treatment was replicated five times with 20 seeds in each replicate and the whole experiment was arranged in a Randomized Block Design. The experiment was carried out in polypots to study the germination and early seedling growth. Soil mixture was prepared for the experiment. Sand, clay and FYM (Farm Yard Manure) in a ratio 2:1:1. The polypots were filled with this soil and the seeds were sown for germination in the polypots in the same orientation. Then the seeds were sown in polypots in the Forestry Nursery. Fertilizers were not used and the seedlings were irrigated daily.

Germination was described by the presence of a radicle at least 2mm long (Mackay et al., 1995). The germinated seeds were counted daily from the starting of the experiment up to the end of the experiment (30 days after seed sowing) and then the germination percentage was calculated (ISTA 1999) by following formula.

$$GP = \frac{\text{Number of seeds germinated upto } n^{th} \text{ day} \quad X\ 100}{\text{Total number of seeds kept for germination}}$$

Germination energy index (GEI) was calculated from daily germination record. For germination energy index an appropriate record of newly germinated seeds was made and GEI was calculated by following equation;

$$GEI = \frac{A_1 + (A_2 + A_2) + (A_1 + A_2 + A_3) + (A_1 + A_2 + A_3 + \ldots\ldots + A_n) \times 100}{Y \times N}$$

Where A_1 , A_2, A_3,…….. A_n is the number of seeds newly germinated on 1,2,3… and n^{th} days, respectively. N is the total number seeds used for the treatment, Y represents the number of days for each observation.

For germination value (GV) germination data were considered upto the day when germination became constant for three consecutive days (peak value). The same day was used as a reference point for computing the germination value and was calculated by following equation (Czabator 1962).

$$G.V. = MDG \times PV$$

Where MDG is mean daily germination and PV is the peak value.

The germination speed (S) was determined by using the following equation (Chiapuso et al., 1997).

$S = (N_1 \times 1) + (N_2 - N_1) \times 1/2 + (N_3 - N_2) \times 1/3 \ldots\ldots\ldots\ldots + (N_n - N_{n-1}) \times 1/n$

Where N1, N2, N3…… Nn-1, Nn = Proportion of germinated seeds observed at 1, 2, ……upto n-1 and nth day.

Vigor index was calculated by using the following equation;

$$V = \%G \times (ASL + ARL)$$

Where V = Vigor index, %G = germination percentage, ASL = Average shoot length, and ARL = Average root length. Shoot length, leaf & leaflet dimensions, rooting pattern were measured on the final day of germination studies.

Data collected on seed morphology, germination and early seedling growth parameters were subjected to Analysis of Variance (ANOVA). This was done to determine the variation among provenances at a 0.05 significant level. The Duncan multiple range test was used to compare means among provenances.

3. Result and Discussion

A significant variation in the seed characteristics of *Albizzia procera* were recorded for different provenances of Chhattisgarh (Table1). The seeds of Raigarh provenance showed a maximum seed weigh, in contrast the seeds from Bastar recorded the minimum value for seed weight. Highest values for seed length and seed width were obtained for Bilaspur provenance and it was followed by Bastar, Raigarh, Sarguja and Korba respectively. The seed thickness does not show any significant difference across all the provenances.

Table 2: Seed characteristics in different provenances of *Albizzia procera* from Chhattisgarh

Provenances	*Seeds weight (gm)*	*Seed Length (cm)*	*Seed Width (cm)*	*Seed Thickness (cm)*	*Viability test*
Bilaspur	0.056 ± 0.002^{c}	0.802 ± 0.017^{a}	0.525 ± 0.022^{a}	0.218 ± 0.011^{a}	100.0^{a}
Bastar	0.032 ± 0.001^{e}	0.744 ± 0.024^{b}	0.472 ± 0.018^{a}	0.194 ± 0.017^{b}	100.0^{a}
Korba	0.069 ± 0.002^{b}	0.502 ± 0.019^{d}	0.302 ± 0.021^{c}	0.112 ± 0.012^{e}	087.7^{b}
Raigarh	0.073 ± 0.003^{a}	0.664 ± 0.070^{c}	0.400 ± 0.012^{b}	0.171 ± 0.017^{c}	097.0^{a}
Sarguja	0.048 ± 0.002^{d}	0.636 ± 0.032^{e}	0.410 ± 0.017^{b}	0.169 ± 0.020^{d}	098.5^{a}
ANOVA (One way)	*	*	*	*	*

Means within a column followed by same letter are not significantly different($P \leq 0.05$). The data shown are mean ± SE of four replicates. Different letters a, b, c and d denote significant difference ($P \leq 0.05$) between the treatments.
*Statistically significant difference at $P \leq 0.05$

Table 3: Pod characteristics in different provenances of ***Albizzia procera*** from Chhattisgarh

Provenances	Pod weight (gm)	Pod Length (cm)	Pod Width (cm)	Pod Thickness (cm)	Avg. Seeds per Pod
Bilaspur	1.07 ± 0.14^{a}	15.6 ± 1.26^{a}	2.12 ± 0.21^{b}	0.209 ± 0.16^{a}	12 ± 1.01^{a}
Bastar	1.36 ± 0.22^{a}	14.1 ± 2.24^{b}	2.87 ± 0.32^{a}	0.172 ± 0.07^{b}	11 ± 1.07^{b}
Korba	0.89 ± 0.09^{b}	11.2 ± 1.90^{d}	1.52 ± 0.17^{c}	0.124 ± 0.04^{d}	08 ± 1.07^{d}
Raigarh	1.21 ± 0.11^{a}	12.2 ± 1.87^{c}	1.66 ± 0.11^{c}	0.157 ± 0.04^{c}	09 ± 1.11^{c}
Sarguja	1.17 ± 0.07^{a}	12.9 ± 1.08^{c}	1.65 ± 0.19^{c}	0.160 ± 0.02^{b}	09 ± 1.09^{c}
ANOVA (One way)	*	*	*	*	*

Means within a column followed by same letter are not significantly different($P \leq 0.05$). The data shown are mean ± SE of four replicates. Different letters a, b, c and d denote significant difference ($P \leq 0.05$) between the treatments.
*Statistically significant difference at $P \leq 0.05$

A significant variation in different pod characteristics was also recorded among the different provenances. A maximum pod length, width and weight were recorded for Bilaspur provenance and it was followed by Bastar, Sarguja, Raigarh and Korba respectively. Average number of seeds per pod was highest in Bastar (12 seeds) provenance and however no significant variation in the number of seeds per pod exist between the other provenances.

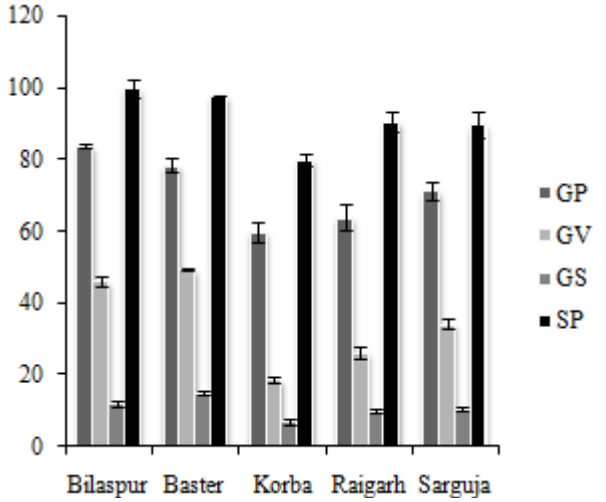

Figure 1: Germination percentage (GP), germination value (GV), germination speed (GS) after one month. The data shown are mean ± SE of four replicates

Seeds of different provenances showed a significantly different germination behavior (Fig).Maximum germination was recorded by the seeds of Bilaspur (84 %) provenance, while minimum germination percentage was obtained by the seeds of Korba (60 %) provenance. Seeds from Bastar provenances indicated highest germination value (GV) and speed of germination (49.56, 15.18) respectively, while these values were lowest for Korba (18.75, 7.13) respectively provenances. The highest survival percent (100%) was recorded by the seedling obtained from the seeds of Bilaspur and Bastar Provenance, however minimum survival percent (80%) was recorded by Korba provenance.

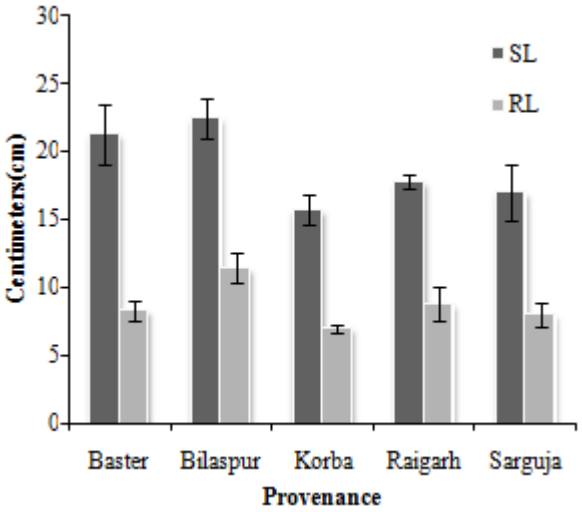

Figure 2: Average shoot and root length (cm) per seedling of five provenances of Albizzia procera. The data shown are mean ± SE of four replicates

The shoot and root length of *Albizzia procera* was significantly different across the different provenances of Chhattisgarh, India. The length of the shoot was recorded highest by the Bilaspur and Bastar provenance. In contrast, the Korba provenance record a minimum length of shoot.The length of roots was observed highest in the seedlings of Bilaspur provenance, however the length of roots was not significantly different for other provenances.

Table 3: Correlation matrix for seed and pod attributes of *Albizzia procera* in different provenances of Chhattisgarh, India

	SWt	SL	SWd	ST	PWt	PL	PWd	PT	ASPP
SWt	1								
SL	0.500*	1.000							
SWd	0.547*	0.990*	1.000						
ST	0.498*	0.993*	0.991*	1.000					
PWt	0.353*	0.893*	0.932*	0.923	1.000				
PL	0.550	0.942*	0.974	0.937	0.938*	1.000			
PWd	0.820	0.688	0.672*	0.629	0.380*	0.653	1.000		
PT	0.393	0.958	0.977	0.966*	0.97*9	0.972	0.520	1.000	
ASPP	0.546	0.949*	0.961*	0.922	0.868*	0.980*	0.746	0.941	1

SWt-Seed Weight,SL-Seed Length,SWd-Seed Width,ST-Seed Thickness,PWt-Pod Weight, PL-Pod Length, PWd-Pod Width,PT-Pod Thickness,ASPP-Average Number of Seeds Per Pod.
*Indicates significant correlation at p≤0.05 level of probability

A highly significant positive correlation (p≤0.05) exist between different seed and pod characteristics (Table-3), which shows that the influence on any of these parameters can cause variation in its correlated parameter. The correlation showed that with the increase of the seed length the seed weight, pod weight and pod length were significantly enhanced. Similar results were obtained for *Acacia nilotica* (Dhillon and Khajuria, 1995) and *Picea smithiana* (Rawat and Uniyal, 2011),

4. Discussion

The purpose for provenances testing is to measure the pattern of genetic variation and to aid in selection of well adapted and highly productive provenances. Phenotypic variation is determined by the genotypic and environmental interaction and is assumed to be expression of genotypic variation when the environmental conditions are controlled (Westoby et al., 2002). Therefore, the screening of provenances is essential to determine the most promising provenances for specific geographic area. Geographic

collection and planting zones can be delineated if provenance testing is conducted during the early stages of a tree breeding programme.In this present study of provenance variation of Albizzia procera, the overall data confirm a significant variation in the seed,pod, germination and seedling characteristics. Ginwal and Gera (2000) have confirmed the variation in seed, germination and seedling characteristics of 12 Acacia nilotica provenances of India. *Albizzia procera* has a wide geoclimatic distribution in India.Thus, it can be one of the reason for its wide morphological and genetic variation.

Across the various seed attributes, the higher variation was exhibited by seed length and seed weight respectively. Tewari (1992) have also reported a wide variation in seed length and seed weight for different provenances of *Azadiractha indica*. Seed weight is one of the useful criteria for early selection of superior provenances (Khalil 1986). In the present study the correlation coefficient between seed length and seed weight was also significant (Table-3).

Across different provenances of *Albizzia procera* in chhattisgarh a significant variation in seed germination, germination value, germination speed and seedling survival rate was recorded. Shu et al.(2012) have also observed a considerable variation in germination of *Magnolia officinalis* seeds collected from different provenances. The variations in germination traits among provenances are also in conformity with those found in *Pinus roxburghii* (Todaria et al. 2003), Picea smithiana (Rawat and Uniyal, 2011), Albizia chinensis (Dhanai et al., 2003), Tectona grandis (Gupta et al., 1976) and Grewia oppositifolia (Uniyal et al., 2003).

The present study identifies Bilaspur and Bastar as two best provenances for *Albizzia procera* in Chhattisgarh based on seed, pod ,germination and seedling growth attributes for all the five provenances which were sampled. On short term basis some specific breeding zones must be set up in the environmentally homogenous areas, which can increase the chances of better seedling establishment of *Albizzia procera* in Chhattisgarh, where the tree is day by day declining in number. The rural people in the state does not show any concern in the plantation of this tree in farm and community lands. One of the reason can be its adaptability and establishment in the early growth periods. In this study we have identified the provenances which can help to overcome this problem. Hence, Bilaspur seed source of *Albizzia procera* provides a great opportunity to the tree breeder to screen and capture natural variation for success of afforestation, besides providing information on the raw material for breeding and evolving improved planting stock within a seed source.

References

[1] Callaham RZ (1964) Provenance Research investigations of genetic diversity associated with geography. Unasylva 18: 40-50.
[2] Chiapuso G, Sanchez AM, Reigosa MJ, Gonzalez L, Pellissier F (1997) Do germination indices adequately reflect allelochemical effects on the germination process. Journal of Chemical Ecology 23: 2445-2453.
[3] Czabator FJ (1962) Germination value: an index combining speed and completeness of Pine seed germination. Forest Science 8: 386-396.
[4] Dangasuk OG, Seurei P, Gudu S (1997). Genetic variation in seed and seedling traits in 12 African provenances of *Faidherbia albida* (Del.) A. Chev. at Lodwar, Kenya. Agroforest Syst 37:133-141.
[5] Devagiri GM (1997). Evaluation of seed source variation in seed and seedling traits in *Dalbergia sissoo* Roxb. Ph.d. Thesis, Forest Research Institute University, Dehra Dun, India.
[6] Dhanai CS, Uniyal AK, Todaria NP (2003). Provenance variation in seed characteristics of *Albizia chinensis*. Indian Journal of Forestry, 26(3): 201–207.
[7] Dhillon GPS and Khajuria HN 1995 Variation in seed Characters of *Acacia nilotica* (L). J. Tropical. Forestry. 2: 17-19
[8] Elmagboul H, Mahgoup S, Eldoma A (2014). Variation in seed morphometric characteristics and germination of *Acacia tortilis* subspecies raddiana and subspecies spirocarpa among three provenances in Sudan. Global J. Bio-Sci. Biotechnol. 3(2): 191–196.
[9] Gera N, Gera M, Purohit M (2000). Source variation in seed and germination characteristics in *Acacia nilotica* wild. Ex Del. Seed Research. 281, 27-31.
[10] Ginwal HS, Gera M (2000). Genetic variation in seed germination and growth performance of 12 *Acacia nilotica* provenances in India. Journal of Tropical Forest Science 12(2):286-297
[11] Ginwal HS, Phartyal SS, Rawat PS, Srivastava RL (2005). Seed source variation in morphology, germination and seedling growth of *Jatropha curcas* linn in central India. Silvae Genet. 54(2): 76–79.
[12] Gupta BN, Pattanath PG (1976). Factors affecting germination behaviour of teak seeds of eighteen Indian origins. Indian Forester. 101:584–588.
[13] International Seed Testing Association (ISTA) (1999) International rules for seed testing. Seed Science and Technology 27: 333.
[14] Khalil MAK (1986). Variation in seed quality and some juvenile characters of White Spruce (*Picea glauca* Moeneu Voss). Silvae Genetica 35(2-3): 78-85.
[15] MackayWA, DavisTD and D sankhla(1995),Influence of scarification and temperature treatments on seed germination of *Lupines havardii*.Seed Science and Technology 23:815-821.
[16] Shu X, Yang X, Yang Z (2012) Variation in Seed and Seedling Traits among Fifteen Chinese Provenances of *Magnolia officinalis*. Not Bot Horti Agrobo,40(2):274-283.
[17] Suri SK (1984). Analytical study of teak provenance test in North Raipur Division of Madhya Pradesh. Indian Journal of Forests 110: 345-363.
[18] Shiv KP, Banerjee AC (1986). Provenance trials of *Acacia nilotica*. Journal of Tree Sciences 5(1): 53-56.
[19] Rawat BS , Uniyal AK (2011). Variability in cone and seed characteristics and seed testing in various provenances of Himalayan spruce (*Picea smithiana*). Journal of Forestry Research. 22(4): 603–610.
[20] Tewari DN (1992) Monograph on Neem (*Azadirachata indica* A Juss). International Book Distributor, Dehra Dun: 279 pp.

[21] Todaria NP, Uniyal AK.(2003). Provenance variation in cone and seed characterstics of *Pinus roxburghii* in Garhwal Himalaya. Annals of Forestry, 11 (1):8-19.
[22] Uniyal AK, Bhatt BP, Todaria NP (2003). Provenance variation in seed and seedling characteristics in *Grewia oppositifolia* Roxb. in Central Himalaya, India. Plant Genetic Resources Newsletter, IPGRI, Rome, Italy, 136: 47–53.
[23] Westoby M, Falster DS, Moles AT, Vesk PA, Wright IJ. 2002. Plant ecological strategies: some leading dimensions of variation between species. Annual Review of Ecology and Systematics 33, 125–159.
[24] Wright JW (1976). Introduction of Forest Genetics. Academic Press, New Genetics. Academic Press, New York.