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Variability Studies on Seed Attributes of *Prosopis juliflora* in South India

S. Reeja*, B. Palanikumaran and K.T. Parthiban

Forest College and Research Institute, Dulapally, Telangana, India

**Corresponding author*

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A B S T R A C T

The present investigation was carried out at Forest College and Research Institute, Mettupalayam, Tamil Nadu to estimate the extent of variability and association present for seed parameters of *Prosopis juliflora Dc*. across its natural distribution in south India for further collection of seeds for afforestation or breeding purpose. The study revealed that seed sources from Tuticorin, Rameshwaram, Ramnad and Keezhakarai exhibit significant amount of variability in all the seed characters investigated viz., seed 2D surface area, seed perimeter, seed length, seed width, seed aspect ratio, hundred seed weight, pod length, number of seeds per pod, viability percentage and germination percentage. These seed sources may be further screened for tree improvement traits considering their immense value in yielding bio diesel.

Introduction

People in the arid zones of South India are mainly dependant on the available scanty resources that the ecosystem provides. The livelihood of the people is made even worse by land degradation caused by over exploitation and the harsh climatic conditions. Economically backward People in this region largely depend on fuelwood and livestock to meet out their ends. The need for a multipurpose tree that caters for fooder, fuel and timber with additional value added derivatives, if any, are considered a natural boon to this society. Fortunately these tracts are largely blessed (though alien and invasive) with the lush growth of ever green spiny mesquite trees, which is seen as a potential and promising package for transforming the lives of the poor for the better in these regions.

Prosopis juliflora is one of the most economically and ecologically important tree species in arid and semi-arid zones of the world and commonly planted in adverse sites where, availability of macro/micro nutrient have potentially been found limiting its growth (Jarrell *et al.,* 1982). Certain physical and physiological characteristics in the ancestral stock may have given prosopis a comparative advantage in such dry zones, allowing for rapid colonization.

Experience with hardy often fast growing tree species, which have been extensively planted as exotic has demonstrated that studies on the genetic variation are critical to continuing success. Prosopis species are essentially out-crossers, which results in a high degree of individual tree variability providing great potential for improving selected characters once they are genetically identified. Possibly one of the most important observations to date is the extensive within family variation suggesting that the critical unit for early improvement is the individual tree rather than family or provenance.

Success in establishment and productivity of forest tree plantations is determined largely by the species used and source of seed within the population (Larsen, 1954; Callaham, 1964 and Lacaze, 1978).

Seed is one of the important inputs for forest nursery production and plantation establishment (Lauridsen and Olesen, 1990). The seeds used for large-scale plantation programmes must be genetically superior to produce timber of higher volume in a shorter period of time. The knowledge available at present on the extent of variation present in the populations of different seed sources and provenances is insufficient to proceed any kind of improvement studies in *Prosopis juliflora*. Hence the present study was initiated to provide resourceful information on variability aspects of seed traits.

Materials and Methods

Location of the study area

The experimental material for the present study consisted of 30 seed sources of *Prosopis juliflora* collected from 30 districts of Tamilnadu. The regulations for seed source sampling concerning minimum number of trees and distance between parent trees, were followed (Lauridsen and Olesen, 1990). Seeds from individual trees were mixed and used as seed source in the present investigation. These experiments were carried out at Forest College and Research Institute, Mettupalayam (11°19' N; 76°56' E; 300 MSL). The actual locations of the seed sources and their geographic features are presented in Table 1.

Determination of variability studies in seed parameters

The physical characters of seed *viz.* 2D surface area (cm^2), perimeter (cm), seed length, seed width and seed aspect ratio were measured using image analyser (Q Win 500 MC + Leica, UK). The seed parameter studies were carried out with a random sample of 20 seeds from each seed source with six replications. Seeds of the sample quantity were spread on a glass platform of macro viewer in replication wise and images were captured and taken into the software called Quantimet 500 + or Q Win. The captured images were calibrated to actual scale. The Q Win identifies the object based on our specification for seed colour. The Q Win measures 2D surface area, perimeter, seed length, seed width and seed aspect ratio of the identified image of the seeds. The seed parameters viz., 2D surface area (cm^2), Perimeter (cm), Length (cm),Width (cm), Aspect ratio, Hundred seed weight (g), Pod length (cm.), Number of seeds/pod, Viability percentage, Germination percentage were studied.

Results and Discussion

The basic aim for any tree improvement programme is the exploitation of available natural variability within the species. The tree improvement programme must always be preceded by the estimation of the extent of variability available in the natural population. The pattern of variability helps to design the testing procedure and identify the superior genotypes based on the described tracts. The largest, cheapest and fastest gains in most forestry tree improvement programmes will accrue if use of suitable species and seed sources within species is assured (Zobel and Talbert, 1984). The choice of provenance and seed source is important since it decides the genetic quality and the physiological potential of the seed. Seeds are influenced by their place of origin (Heydecker, 1972), especially due to environmental variations in latitude, altitude, rainfall, temperature, moisture and the external factors (Shivakumar and Bannerjee, 1986). The seed source variations were reported in many tree species (Bagchi and Dobriyal, 1990; Mishra and Bannerjee, 1995; Thapliyal and Dhiman, 1997; Pathak, 1998; Mohit Gera *et al.,* 1999) and were dictated by environmental and edaphic factors. This may also be due to altitudinal variation (Barnett and Farmer, 1978) or region of collection (Bonner, 1984).

The present study revealed that significant amount of variability exists among different seed sources in all the seed characters investigated viz., seed 2D surface area, seed perimeter, seed length, seed width, seed aspect ratio, hundred seed weight, pod length, number of seeds per pod, viability percentage and germination percentage. The seed source Keezhakarai registered the highest and significant values for seed 2D surface area (0.061 cm^2), seed perimeter (1.456 cm), seed length (0.365 cm) and seed weight (0.255 cm) (Table 2). Similarly, superiority in aspect ratio was recorded by Salem (0.825) and Nagercoil (0.795) seed source. Tirunelveli seed source exhibited significant values for 100 seed weight (3.555 g). The variation in seed physical characters must be attributable to differences in physiographic, edaphic and climatic factors (Mathur *et al.,* 1984; Padmini and Bannerjee, 1986).

In the present study, seeds were collected from 30 different sources, which had the wide latitude ranging from 8^o 11’ N to 12^o 55’ N and the longitude from 77^o00’ E to 80^o 01’ E, which might be the reason for the variability in seed parameters. Such variation in seed parameters were also earlier well documented in *Acacia auriculiformis* and *A. mangium* (Hegde *et al.,* 2000), *A. nilotica* (Vanangamudi *et al.,* 1998), *Albizia lebbeck* (Radhakrishnan, 2001), *Tectona grandis* (Parthiban, 2001), *Tamarindus indica* (Divakara, 2009), *Simarouba glauca* (Masilamani *et al.,* 2004), *Terminalia* (Srivastav and Thangavelu, 2003), *Albizia chinensis* (Dhanai *et al.,* 2003) and *Acacia catechu* (Rajesh Kumar *et al.,* 2004). In the current investigation the seed source viz., Sivaganga scored higher values for pod length (23.05 cm). The number of seeds per pod is found to be more in Rameshwaram pods (29.00). Similarly viability percentage is higher for Tuticorin seed source (94.50%) followed by Tirunelveli (93.00), Rameshwaram and Ramnad (92.00%). Higher germination percentage is recorded by Pollachi (90.5%) and Rameshwaram (92.00%) seed sources followed by Theni (88.00%), Coimbatore (87.50%) and Ramnad (87.5%) (Table 2; Fig. 1). Genetic factors influence is an important role in deciding germination, survival and establishments of seeds. Variation in seed germination due to seed sources were also reported in *Acacia auriculiformis* and *A. mangium* (Ramakrishnan Hegde *et al.,* 2000), *Acacia catechu* (Rajesh Kumar *et al.,* 2004), *Casuarina equisetifolia* (Jambulingam, 1990), *Dalbergia latifolia* (Mohit Gera *et al.,* 1999), and *Tectona grandis* (Masilamani *et al.,* 1999; Parthiban, 2001).

The choice of provenance and seed source is important since it decides the genetic quality and the physiological potential of the seed. Genetic factors coupled with environmental factors influence germination, survival and establishment behavior of seed. The study confirms the enormous variation that exists in nature in different seed sources for various seed characters of *Prosopis juliflora.* The present study revealed that seed sources from Tuticorin, Rameshwaram, Ramnad and Keezhakarai exhibits significant amount of variability in all the seed characters investigated.

Table.1 Details of the seed sources

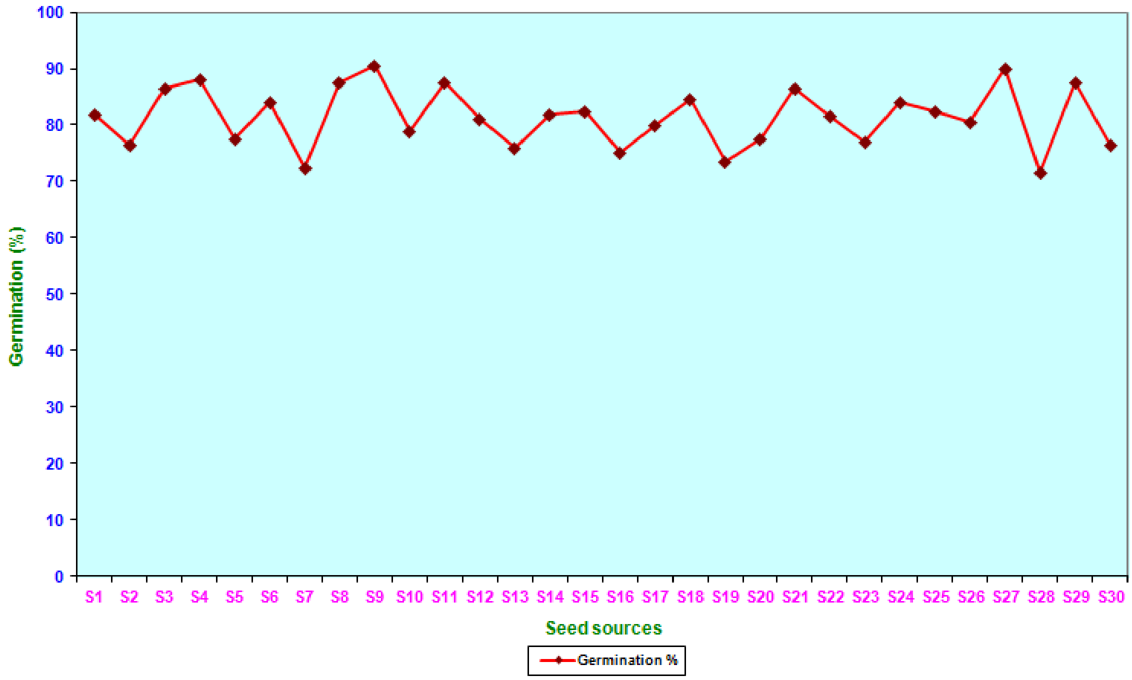
Source No.	Seed source	Latitude	Longitude
S_1	Bodi	10°01'N	77°00'E
S_2	Vellore	12°55'N	79°11'E
S_3	Madurai	9°58'N	78°10'E
S_4	Theni	9°68'N	79°86'E
S_5	Kancheepuram	12°50'N	79°45'E
S_6	Dindigul	10°22'N	78°00'E
S_7	Chengam	12°15'N	79°07'E
S_8	Tuticorin	8°48'N	78°11'E
S_9	Pollachi	10°39'N	77°03'E
S_{10}	Tirunelveli	8°44'N	77°44'E
S_{11}	Coimbatore	11°00'N	77°10'E
S_{12}	Villupuram	11°57'N	79°32'E
S_{13}	Tirupathur	11°68'N	79°25'E
S_{14}	Sivaganga	10°62'N	79°15'E
S_{15}	Trichy	10°50'N	78°46'E
S_{16}	Pudukottai	10°23'N	78°52'E
S_{17}	Chennai	12°42'N	80°01'E
S_{18}	Sivakasi	9°27'N	77°36'E
S_{19}	Cuddalore	11°43'N	76°58'E
S_{20}	Virudhunagar	9°35'N	77°57'E
S_{21}	Aruppukkottai	9°31'N	78°08'E
S_{22}	Erode	11°20'N	77°46'E
S_{23}	Perambalur	11°14'N	78°56'E
S_{24}	Keezhakarai	9°14'N	78°50'E
S_{25}	Sankarankoil	9°10'N	77°35'E
S_{26}	Salem	11°39'N	78°12'E
S_{27}	Rameshwaram	9°17'N	79°22'E
S_{28}	Dharmapuri	12°08'N	78°13'E
S_{29}	Ramnad	9°22'N	78°52'E
S_{30}	Nagercoil	8°11'N	77°29'E

Table.2 Seed source variations in seed physical characters

Seed sources	2D surface area (cm^2)	Perimeter (cm)	Length (cm)	Width (cm)	Aspect ratio	100 seed weight (g)	Pod length (cm)	No. of seeds/ pod	Viability (%)	Germination %
S_1	0.050	1.300	0.315	0.240	0.765	3.260*	18.000	24.000	86.500	82.000
S_2	0.029	0.775	0.235	0.170	0.725	2.745	14.250	22.000	87.500	76.500
S_3	0.050	1.300	0.335*	0.240	0.740	3.195*	22.500*	23.000	92.500*	86.500
S_4	0.035	0.940	0.260	0.195	0.765	3.045	18.000	23.500	82.500	88.000*
S_5	0.051	1.200	0.345*	0.245	0.745	2.730	13.050	19.000	77.000	77.500
S_6	0.039	1.350*	0.310	0.210	0.685	2.790	19.450	23.000	90.000*	84.000
S_7	0.039	1.100	0.280	0.205	0.755	2.750	16.800	25.500	88.000	72.500
S_8	0.052*	1.130	0.295	0.190	0.645	3.330	21.300*	26.500	94.500*	87.500*
S_9	0.032	1.025	0.260	0.205	0.775	2.915	18.750	24.500	93.000*	90.500*
S_{10}	0.042	1.050	0.295	0.225	0.745	3.555*	22.650*	22.500	87.500	79.000
S_{11}	0.053*	1.450*	0.330	0.245	0.730	3.215*	20.750*	24.000	84.500	87.500*
S_{12}	0.034	0.845	0.260	0.190	0.685	2.990	14.600	25.500	79.000	81.000
S_{13}	0.040	1.000	0.270	0.210	0.770	2.895	18.100	23.500	81.500	76.000
S_{14}	0.048	1.250	0.300	0.170	0.605	3.470*	23.050*	25.000	78.500	82.000
S_{15}	0.043	1.100	0.310	0.205	0.655	2.690	17.425	23.500	74.000	82.500
S_{16}	0.052*	1.300	0.325	0.260*	0.790*	2.660	16.700	23.000	67.500	75.000
S_{17}	0.043	1.100	0.300	0.215	0.720	2.795	12.450	17.000	76.500	80.000
S_{18}	0.044	1.050	0.295	0.255*	0.780	2.550	16.020	21.350	74.500	84.500
S_{19}	0.041	0.995	0.275	0.210	0.750	2.765	18.900	20.500	71.000	73.500
S_{20}	0.032	0.795	0.255	0.170	0.655	2.870	17.900	25.000	81.000	77.500
S_{21}	0.043	1.150	0.290	0.225	0.765	2.865	19.385	27.500*	76.000	86.500
S_{22}	0.051	1.300	0.330	0.235	0.710	2.740	13.885	24.500	86.000	81.500
S_{23}	0.032	0.815	0.250	0.175	0.695	2.680	16.150	20.000	72.000	77.000
S_{24}	0.061*	1.456*	0.365*	0.255*	0.720	3.060*	14.250	26.000	83.500	84.000
S_{25}	0.033	0.865	0.240	0.185	0.780	2.850	21.650	24.500	85.000	82.500
S_{26}	0.045	1.150	0.295	0.245	0.825*	2.710	15.345*	20.000	70.000	80.500
S_{27}	0.047	1.150	0.310	0.230	0.750	3.235*	12.250	29.000*	92.000*	90.000*
S_{28}	0.044	1.250	0.300	0.230	0.785*	2.625	16.300	24.500	70.000	71.500
S_{29}	0.040	1.050	0.295	0.205	0.695	3.350*	14.150	26.500	92.000*	87.500*
S_{30}	0.049	1.200	0.310	0.245	0.795*	2.920	19.500	23.000	86.500	76.500
Mean	0.041	1.115	0.294	0.216	0.704	2.942	17.450	23.578	81.983	81.367
SEd	0.005	0.112	0.018	0.016	0.038	0.056	1.186	1.714	3.686	2.528
CD	0.010	0.229	0.036	0.033	0.077	0.115	2.425	3.505	7.540	5.170

* Significant at 5% level

Fig.1 Seed source variation for germination (%)



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