GENETIC ANALYSIS FOR SEED TRAITS IN *ACACIA NILOTICA* (LINN.) WILLD. EX DEL SSP. *INDICA* (BENTH.) BRENAN (BABUL)

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Introduction

The potential of *Acacia nilotica* (L.) Del ssp. Indica (Benth.) Brenan (locally known as Babul) is a world wide multipurpose tree (National Academy of Sciences, 1980). This species is found in tropical and sub tropical Africa and Asia, and through out dry and hot regions of India ranging from 9° N to 34° N latitude and 72° E to 92° E longitude, and ascending to an altitude of 900 m. It withstands an absolute maximum temperature of 50° C, minimum temperature of -5° C and can be supported by an annual rainfall of 75 to 1, 300 mm. *A. nilotica* is a small sized nitrogen fixing tree and forms an important source of timber fuelwood, fodder, tannin and gum on farm lands in rural India. It has a strong vertical and horizontal root system (Toky and Bisht, 1992), and a long shoot extention period of more than 300 days with four peaks of leaf flush (Bisht and Toky, 1993). Due to these ecological characteristics, the species is exceedingly drought tolerant, survives on the difficult soil sites and is preferred for reforestation of wastelands.

A few provenance trials on *A. nilotica* have been conducted in India, and these studies reported significant variation in seed characteristics (Bagchi *et al.*, 1990a; Bagchi and Dobriyal, 1990b; Krishan and Toky, 1996a), seed germination and seedling vigour (Bagchi and Dobriyal, 1990b; Krishan and Toky, 1996b). Improvement in germination through pod and seed size has been reported in case of *Albizia chinensis* (Dhanai *et al.*, 2003; Sachan *et al.*, 2006), *Albizia lebbek* Benth (Todaria *et al.*, 2002, 2003), *A. nilotica* (Dar *et al.*, 2009). The magnitude of improvement in germination through seed size, however, depends upon the amount of genetic variability and heritability of the trait. The present study was carried out to estimate genetic variability, heritability and genetic gain present for various seed traits for their possible exploitation for improving germination in *Acacia nilotica*.

Material and Methods

Seeds were collected from thirty seed sources of *Acacia nilotica*, three from Haryana, six from Himachal Pradesh and twenty one from Punjab. Data on various seed traits, *viz.*, pod length (cm), pod width (cm), pod thickness (cm), number of seed per pod, pod weight (g), seed length (cm), seed width (cm), seed thickness (mm), 100 seed weight (g) and germination per cent were recorded in all progenies in triplicate. For studying germination, seeds of all seed sources were immersed in hot water (80°C) for about 30 minutes followed by soaking in cold water for 24 hours before sowing. Fifteen seeds of each progenies were placed in Petriplate lined with single layer of filter paper moistened with distilled water. All entries were replicated thrice and kept at 30 ± 25°C in a seed germinator. Total number of seeds that germinated in twelve days, were counted and per cent germination was worked out for each of the seed sources. Data was subjected to analysis of variance, phenotypic and genotypic co-efficient of variation, heritability and genetic gain was calculated as suggested by Johnson *et al.* (1955). Simple correlations were calculated between various seed traits and per cent germination following Senedecor and Cocharan (1967).

Result and Discussion

The range, mean and F-values for various characters are given in Table 1. The maximum range of variability was exhibited for per cent germination followed by number of seed per pod and pod length and minimum by 100 seed weight. High F-values showed the presence of high genetic variability for all the pod and seed traits. However 100 seed weight had the highest genetic variability followed by seed width and seed length.

The estimates of coefficient of phenotypic and genotypic variation, heritability and genetic gain are given in Table 2. Per cent germination had the highest value of the co-efficient of phenotypic and genotypic variations followed by pod length and 100 seed weight. This indicated high genetic variability for these traits. Pod thickness had the lowest values of both the co-efficient of phenotypic and genotypic variation. The heritability estimates (Table 3) were found highest for all the traits except number of seed per pod (43.15%). The expected genetic gain expressed as per cent of mean by selecting the best were found to be highest for seed length followed by seed width and 100 seed weight.

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Table 1

Analysis of variance for different characters in Acacia nilotica

Characters	Range	Mean		SD±	Sem	F Value
		Maximum	inimum			
Pod length (cm)	18.09	16.4	10.05	2.62	0.62	14.02**
Pod width (cm)	1.04	1.5	1.02	1.14	0.02	3.06**
Pod thickness (cm)	1.03	1.4	1.01	0.16	0.03	26.10**
No. of seeds/pod	15.00	13.00	9.00	1.38	0.12	11.03**
Pod weight (g)	2.21	2.63	2.07	1.07	0.04	7.05**
Seed length (mm)	5.00	7.53	6.01	2.05	0.22	9.07**
Seed width (mm)	6.00	6.78	5.52	2.01	0.13	6.12**
Seed thickness (mm)	4.00	4.11	3.09	0.72	0.11	46.15**
100 seed weight (g)	17.21	18.33	11.52	2.28	0.21	9.03**
Germination (%)	72.00	83.00	41.00	32.00	0.83	22.09**

** Significant at 1 per cent level

Table 2

Phenotypic (PCV) and genotypic (GCV) co- efficient of variation, heritability and genetic gain in Acacia nilotica

Characters	PCV	GCV	Heritability %	Genetic gain	Genetic gain as per cent of mean
Pod length	25.31	21.18	87.31	0.63	71.45
Pod width	12.67	10.09	76.12	1.48	70.91
Pod thickness	4.09	3.18	81.53	0.72	78.55
No. of seeds/pod	6.61	3.61	43.15	2.65	40.31
Pod weight	9.32	6.82	75.27	0.55	72.18
Seed length	11.83	9.35	83.19	4.67	88.15
Seed width	9.45	5.95	85.18	3.21	87.61
Seed thickness	8.38	6.33	95.35	0.92	74.42
100 seed weight	24.87	19.13	93.47	1.81	87.35
Percent germination	29.53	18.51	68.38	18.07	40.21

Table 3

Correlation co-efficient in Acacia nilotica.

Characters	Pod width	Pod thickness	No. of seeds/pod	Pod weight	Seed length	Seed width	Seed thickness	100 seed weight	Per cent germination
Pod length	0.59**	0.18^{NS}	0.62**	0.51**	0.37^{NS}	0.19^{NS}	0.22^{NS}	0.76**	0.57**
Pod width		0.72**	0.41^{NS}	0.78**	0.52**	0.15^{NS}	0.47^{NS}	0.33^{NS}	0.45^{NS}
Pod thickness			0.68**	0.49**	0.21^{NS}	0.21^{NS}	0.41^{NS}	0.25^{NS}	0.14^{NS}
No. of seeds/pod				0.81**	0.29^{NS}	0.53**	0.49**	0.48**	0.15^{NS}
Pod weight					0.52**	0.87**	0.41^{NS}	0.56**	0.49**
Seed length						0.91**	0.72**	0.51**	0.60**
Seed width							0.82**	0.79**	0.55**
Seed thickness								0.79**	0.63**
100 seed weight									0.69**

** Significant at 1 per cent level respectively NS- Non Significant

Number of seed per pod showed the lowest genetic gain. The traits showing high genetic gain also had high heritability and genetic variability as evident from genotypic co-efficient of variation (Table 2). Johnson *et al.* (1955) in soyabean, Manga and Sen (1996) in *Prosopis cineraria*, Dhanai *et al.* (2003) in *A. chinensis* reported that heritability estimates along with estimates of expected genetic

gain is more useful than heritability itself in predicting the resultant effect for selecting the best genotypes for a given traits. Presence of high heritability along with high genetic gain for traits like seed length, seed width, number of seed per pod and seed thickness indicated that additive genes were responsible for high heritability of these traits. Consequently selection of desirable types would be successful in improving these traits has been reported by Dhanai *et al.* (2003) in *A. chinensis* and Todaria *et al.* (2003) in *A. lebbek*. Correlation study (Table 3) revealed that most of the seed traits except pod width, pod thickness and number of seed per pod associated non-signigicant positively with each other. Pod thickness, pod weight, seed length, seed width, seed thickness and 100 seed weight associated significantly and positively with per cent germination. The results obtained in the present study are in line with the findings of Bhat and Chauhan (2002) and Todaria *et al.* (2003) in *A. lebbek*, Dhanai *et al.* (2003) and Sachan *et al.* (2006) in *A. chinensis* and Manga and Sen (1996) in *Prosopis cineraria*. This implied that per cent germination can be improved by selecting for higher manifestation of any one of these traits. Based on genetic observations and correlation studies, it is suggested that seed length, seed width and 100 seed weight can be utilized as effective parameters for improving germination in this tree species.

SUMMARY

Genetic parameters for nine pod and seed traits, and per cent germination were worked out in thirty seed sources of *Acacia nilotica* mostly from the state of Haryana, Himachal Pradesh and Punjab. Values for variability expected genetic gain were calculated for all individual characters. Seed length, seed width and 100 seed weight exhibited high genetic variability, heritability and genetic gain. Correlation study revealed that pod thickness; pod weight, seed length, seed width, seed thickness and 100 seed weight had significant and positive association with germination percentage. These traits therefore should be given priority for improving germination in *Acacia nilotica*.

***Key words*:** Genetic gain, Genetic variability, Heritability, Seed Traits, Germination per cent, Seed source and *Acacia nilotica*.

अकेसिया नीलोटिका (लि॰) विल्डे॰ पूर्व डेलि उपजाति *इण्डिका* (बैंथ॰) ब्रेनन (बबूल) के बीज लक्षण जानने को उनका आनुवांशिक विश्लेषण

मो॰ अय्युब दर, एस॰ नौटियाल, मीना बख्शी, एच॰ मेहता, ओ॰ पी॰ चतुर्वेदी व जे॰ एम॰ एस॰ तोमर

सारांश

अकेसिया नीलोटिका के तीस बीज स्रोतों की, जिनमें से अधिकांश स्रोत हरियाणा, हिमाचल प्रदेश और पंजाब के थे, फलियो और बीज लक्षणों के आनुवांशिक परिणाम और प्रतिशत अंकुरण क्षमता ज्ञात की गई। सभी विशेषताओं को विभिन्नता से प्रत्याशित आनुवांशिक लाभ की अर्हाएं आकलित की गई। बीजों की लम्बाई, बीजों की चौड़ाई और प्रति 100 बीजों के भार में अधिक आनुवांशिक विभिन्नीयता, पितृदायिता और आनुवांशिक लाभ होता मिला। सहसंबंधन से पता चला कि फलियों की मोटाई, फली भार, बीज की लम्बाई, बीज की चौड़ाई, बीज की मोटाई, 100 बीजों के भार का अंकुरण प्रतिशत के साथ सार्थक और सकारात्मक संबंध रहता है। इसलिए *अकेसिया नीलोटिका* के अंकुरण में सुधार लाने के लिए इन लक्षणों को प्राथमिकता दी जानी चाहिए।

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