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# Variability Studies on Pod and Seed Characteristics of *Acacia nilotica* (L.) Wild Ex. Del.

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**Abstract:** Genetic variability and correlation in different pod and seed characters of *Acacia nilotica* were studied. High values of heritability were observed for all the characters, except seed width (23.52%) and seed length (45.2%), while high genetic advance was observed for vigor index-II, vigor index-I, shoot length, seedling dry weight and root length. One hundred seed weight had significant positive correlation with all the characters except seed per pod and electrical conductivity. Seed per pod had non-significant positive correlation with 100-seed weight, while EC had significantly negative correlation with all the characters.

**Key words**: Variation, *Acacia nilotica*, heritability, genetic advance, correlation.

*Acacia nilotica* (L.) Wild Ex. Del., commonly known as babul or kikar, belongs to the family leguminosae. It is indigenous to the western part of the Indo-Gangetic plain and the northern part of the Deccan Plateau where it is scattered throughout agricultural fields, along railway lines, public highways, bunds and embankments. Its timber qualities are hard and tough wood, resistant to termites, impervious to water and popular for tool handles and carts. Its gum is used for matches, paints, and calico printing and dyeing, as a sizing material for silk and cotton and in manufacture of paper. Inspite of its economic importance and potential as a valuable afforestation species, studies on its genetic improvement are limited. Hence, variability studies, which provide the basic information required for genetic improvement of any tree species, were undertaken with respect to seed and pod characters.

## Material and Methods

The experimental material was collected from 9 different locations (3 from arid region, viz., Sirsa, Mahendragarh and Rewari; 3 from semi-arid region, viz., Sonepat, Jind and Bhiwani; 3 from sub-humid region, viz., Panchkula, Karnal and Kaithal) of Haryana during June-July 1998. Seed pods were collected by randomly selecting five trees from each location. Observations on pod length, seed per pod, seed length, seed width, seed thickness, 100-seed weight, seed volume, tetrazolium test, standard germination, electrical conductivity (EC), seedling length, seedling dry weight, vigor index-I [standard germination (%) x seedling length (cm)] and vigor index-II [standard germination (%) x dry weight of seedling (mg)] were recorded in three replications. Analysis of variance was carried out following Panse and Sukhatme (1978). Estimates of heritability (broad sense) and genetic advance (% of mean) were calculated

by formula given by Johnson *et al.* (1955) and Lush (1949), respectively. The phenotypic and genotypic correlation coefficients were calculated as per Robinson *et al.* (1951).

## Results and Discussion

The analysis of variance showed that mean sum of squares were highly significant for most of the characters except seed width, which was non-significant (Table 1). The significance of mean square due to seed sources in almost all the characters indicates considerable variability, thereby suggesting good scope for improvement.

The values (Table 1) of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) ranged from 1.23 and 2.55 (seed width) to 17.27 and 17.90% (vigor index-I). The differences between PCV and GCV for all the characters were very small, indicating thereby less influence of environment, and reflect on the reliability of selection based on phenotypic performance. Similar trends were also observed in *A. nilotica* (Shivkumar and Banerjee, 1986) and *Dalbergia sissoo* (Dhillon *et al.*, 1995).

High values of heritability were observed in almost all the characters except seed width (23.52%) and seed length (45.20%). The heritability in broad sense ranged from 23.52 to 97.29% and genetic advance as per cent of mean from 1.23 to 34.85% for various characters.

*Table 1. Analysis of variance and magnitude of variation for seed quality and seedling vigor parameters in Acaica nilotica*

| Parameters | Analysis of variance | | | | Magnitude of variation | | | |
|---|---|---|---|---|---|---|---|---|
| | Treatment | Error | F cal | Signi-ficance | GCV | PCV | $h^2$ | GA as % of mean |
| Pod length | 0.7575 | 0.0961 | 7.878 | ** | 3.23 | 3.87 | 69.62 | 5.55 |
| Seed per pod | 0.5903 | 0.5903 | 0.0670 | ** | 4.49 | 5.28 | 72.23 | 7.86 |
| Seed length | 0.0973 | 0.0280 | 3.475 | * | 1.93 | 2.88 | 45.20 | 2.68 |
| Seed width | 0.0455 | 0.0237 | 1.923 | NS | 1.23 | 2.55 | 23.52 | 1.23 |
| Seed thickness | 0.1081 | 0.0091 | 11.877 | ** | 4.72 | 5.34 | 78.38 | 8.62 |
| Seed weight | 3.8160 | 0.1204 | 31.684 | ** | 7.49 | 8.82 | 72.07 | 13.10 |
| Seed volume | 2.5092 | 0.2870 | 8.742 | ** | 7.81 | 8.18 | 91.09 | 15.36 |
| Tertrazolium test | 48.3333 | 2.4444 | 19.773 | ** | 4.48 | 4.83 | 86.22 | 8.58 |
| Standard germination | 41.3703 | 4.5370 | 9.118 | ** | 4.58 | 5.36 | 73.01 | 8.07 |
| EC at 24 h | 1.1836 | 0.0321 | 36.808 | ** | 4.66 | 4.85 | 92.26 | 9.22 |
| Root length | 1.2699 | 0.0544 | 23.306 | ** | 13.33 | 14.20 | 88.14 | 25.78 |
| Shoot length | 3.5468 | 0.0869 | 40.809 | ** | 15.08 | 15.64 | 92.99 | 29.97 |
| Seedling dry wt. | 317.2887 | 2.9165 | 108.79 | ** | 13.72 | 13.91 | 97.29 | 27.88 |
| Vigor index-I | 76185.5024 | 1830.6172 | 41.617 | ** | 17.27 | 17.90 | 93.12 | 34.33 |
| Vigor index-II | 2921765.6060 | 31634.6955 | 92.360 | ** | 17.19 | 17.47 | 96.82 | 34.85 |

* Significant at P <0.005, ** Significant at P <0.01, NS = Non-significant.
GCV = Genotypic co-efficient of variation, PCV = Phenotypic co-efficient of variation, $h^2$ = Heritability (broad sense); GA = Genetic advance.

High genetic advance was observed for vigor index-II (34.85), which was followed by vigor index-I (34.33), shoot length (29.97), seedling dry weight (27.88) and root length (25.78). In characters like seed weight, root length, shoot length, seedling dry weight, vigor index-I and vigor index-II, high heritability in conjunction with high genetic advance in percentage of mean indicates that heritability is largely due to additive gene effects and low gene advance, coupled with low heritability for pod length, seed/pod, seed length, seed width, seed thickness, volume, viability, germination percentage, EC, etc. This indicates non-additive genetic effect, resulting in low genetic gain for these characters from selection. These results coincide with the findings of Srivastava *et al.* (1993) in *Terminalia arjuna* and Patil *et al.* (1997) in *Eucalyptus*.

The genotypic correlation (Table 2) was higher than phenotypic correlation (Table 3) and the low phenotypic correlations were obtained because of modifying effects of environment on genotype for most of the seed characters. Hundered seed weight had highly significant positive correlation with all the characters except seed per pod. It also had significantly high negative correlation with EC. Pod length showed significantly positive correlation with seed thickness, seed volume, seedling dry weight and vigor index-II and non-significant positive correlation with all other characters, except seed length and EC. With seed length it showed highly significant positive correlation, while with EC it was negatively correlated. Seed per pod had significant positive correlation with viability and non-significant positive correlation with seed width, seed thickness, volume of seed, shoot length, seedling dry weight and vigor index-II. It showed negative and non-significant correlation with all the other characters. Seed length had significant positive correlation with seed volume, seedling dry weight and vigor index-II, whereas it had significantly high negative correlation with EC. It also showed non-significant positive correlation with rest of the characters. Seed width showed significantly positive correlation with seed thickness, germination percentage, shoot length, vigor index-I, vigor index-II and negative correlation with EC. It also had non-significant positive correlation with seed volume, viability, root length and seedling dry weight. Viability, germination percentage, root length, seedling dry weight, vigor index-I and vigor index-II had significantly positive correlation with seed thickness, while seed volume and shoot length had non-significant positive correlation and EC had highly significant negative correlation with seed thickness. Seed volume gave highly significant positive correlation with viability, shoot length, seedling dry weight, vigor index-I, vigor index-II and highly significant negative correlation with EC. It also had significant positive and non-significant positive correlations with root length and germination percentage, respectively. Seed viability, germination percentage, root length, shoot length, seedling dry weight, vigor index-I and vigor index-II had highly significant positive correlation with each other, and these characters also had highly significant negative correlation with EC. Similar results were also reported by Hooda and Bahadur (1993) in *Leucaena leucocèphala*, Kamboj (1994), Manga and

*Table 2. Genotypic corrleation among various seed and seedling vigor parameters in A. nilotica*

| Parameters | Pod length | Seed per pod | Seed length | Seed width | Seed thick-ness | Seed volume | Viabi-lity (TZT) | Standard germi-nation | EC | Root length | Shoot length | Seedling dry weight | Vigor index-I | Vigor index-II |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100-seed wt. | 0.704 | 0.199 | 0.889 | 0.958 | 0.617 | 0.983 | 0.710 | 0.443 | -0.735 | 0.592 | 0.687 | 0.738 | 0.665 | 0.728 |
| Pod length | | 0.18 | 1.227 | 0.306 | 0.769 | 0.620 | 0.185 | 0.224 | -0.336 | 0.344 | 0.286 | 0.550 | 0.325 | 0.526 |
| Seed per pod | | | -0.109 | 0.657 | 0.194 | 0.418 | -0.489 | -0.104 | -0.222 | -0.299 | 0.068 | 0.092 | -0.056 | 0.079 |
| Seed length | | | | 0.331 | 0.650 | 0.916 | 0.397 | 0.350 | -0.579 | 0.468 | 0.465 | 0.736 | 0.488 | 0.703 |
| Seed width | | | | | 0.911 | 0.989 | 1.102 | 1.089 | -0.995 | 0.734 | 1.053 | 0.763 | 1.066 | 0.925 |
| Seed thickness | | | | | | 0.489 | 0.460 | 0.608 | -0.603 | 0.429 | 0.517 | 0.611 | 0.554 | 0.668 |
| Seed volume | | | | | | | 0.755 | 0.386 | -0.738 | 0.580 | 0.739 | 0.809 | 0.658 | 0.747 |
| Viability (TZT) | | | | | | | | 0.642 | -0.945 | 0.416 | 0.630 | 0.707 | 0.636 | 0.753 |
| Standard germination | | | | | | | | | -0.895 | 0.540 | 0.629 | 0.596 | 0.744 | 0.739 |
| EC | | | | | | | | | | -0.583 | -0.739 | -0.817 | -0.807 | -0.908 |
| Root length | | | | | | | | | | | 0.950 | 0.853 | 0.942 | 0.829 |
| Shoot length | | | | | | | | | | | | 0.905 | 0.985 | 0.904 |
| Seedling dry weight | | | | | | | | | | | | | 0.904 | 0.981 |
| Vigor index-I | | | | | | | | | | | | | | 0.928 |

*Table 3. Phenotypic correlation among various seed and vigor parameters in A. nilotica*

| Parameters | Pod length | Seed per pod | Seed length | Seed width | Seed thick-ness | Seed volume | Viabi-lity (TZT) | Stand-ard germi-nation | Electri-cal conducti vity | Root length | Shoot length | Seed-ling dry weight | Vigor index-I | Vigor index-II |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100-seed wt. | 0.582** | 0.185 | 0.632** | 0.392* | 0.502** | 0.821** | 0.651** | 0.385* | -0.691** | 0.530** | 0.647** | 0.696** | 0.618** | 0.678** |
| Pod length | | 0.007 | 0.566** | 0.216 | 0.466* | 0.458* | 0.077 | 0.077 | -0.280 | 0.227 | 0.261 | 0.430* | 0.238 | 0.384* |
| Seed per pod | | | -0.096 | 0.225 | 0.228 | 0.353 | -0.405* | -0.106 | -0.172 | -0.235 | 0.024 | 0.040 | -0.072 | 0.029 |
| Seed length | | | | 0.079 | 0.418 | 0.400* | 0.249 | 0158 | -0.418* | 0.260 | 0.236 | 0.510** | 0.261 | 0.472* |
| Seed width | | | | | 0.423* | 0.211 | 0.364 | 0.432* | -0.525* | 0.360 | 0.422* | 0.346 | 0.461* | 0.408* |
| Seed thickness | | | | | | 0.262 | 0.410* | 0.564* | -0.487** | 0.444* | 0.374 | 0.502** | 0.496** | 0.593* |
| Seed volume | | | | | | | 0.631** | 0.275 | -0.576** | 0.421* | 0.649** | 0.699** | 0.540** | 0.634** |
| Viability (TZT) | | | | | | | | 0.540** | -0.832** | 0.397* | 0.579** | 0.636** | 0.600** | 0.693** |
| Standard germination | | | | | | | | | -0.713** | 0.500** | 0.508** | 0.477* | 0.711** | 0.684** |
| EC | | | | | | | | | | -0.511** | -0.698** | -0.768** | -0.743** | -0.842** |
| Root length | | | | | | | | | | | 0.862** | 0.775** | 0.912** | 0.777** |
| Shoot length | | | | | | | | | | | | 0.869** | 0.953** | 0.862** |
| Seedling dry weight | | | | | | | | | | | | | 0.854** | 0.965** |
| Vigor index-I | | | | | | | | | | | | | | 0.909** |

* Significant at 5% level; ** Significant at 1% level.

Sen (1996) in *Prosopis cineraria* and Chopra (1998) in *Prosopis juliflora*. From the present study it can be concluded that higher seed weight, viability and low EC gave vigorous seedling, which is helpful in obtaining superior stands.

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