

**Genetic divergence in babul (*Acacia nilotica*)**Sudhanshu Shekhar<sup>1</sup>, V.P. Dwivedi<sup>2</sup> and \*N.K. Srivastava<sup>1</sup>Department of Genetics and Plant Breeding,<sup>2</sup>Department of Agronomy

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**Received :** 08.04.2019; **Accepted :** 05.05.2019**ABSTRACT**

Genetic divergence of Babul (*Acacia nilotica*) was assessed using Mahalanobis  $D_2$  statistics. They were grouped into eight clusters. Maximum genetic distance was recorded between III & VIII clusters indicating greater distance between two clusters that showed maximum diversity amount the genotype and helps in hybridization programme.

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KEY WORDS :  $D_2$  statistic, Genetic divergence, Hybridization, Provenance.**Introduction**

As renewable natural resources for mankind and for maintaining the ecological balance, the forests are of the great importance. They supply

economical important products, various kinds of food materials, medicines dyes, resins, tannins and wood. The wood of Babul is hard and tough and it is used for several purposes viz. cart wheels,

**TABLE - 1 : Grouping of number of seed sources into different clusters.**

| Cluster | No. of Seed sources provenances | Codes of Provenances   | State  |
|---------|---------------------------------|--|--|
| I       | 28                              | PI,P4,P5,P6,P8,PII,P13,P14,P15,P16,P17,P18,<br>P20PP21,P23,P26,P27,P28, P3,P32,P33,P34,<br>P35,P36,P37,P38,P39,P40 | M,UP, G, B,<br>G, B, M, H, R, R,<br>UP, T, C.<br>Respectively. |
| II      | 5                               | P2,P3,P7,P19,P24   | M,P,M,UP, T  |
| III     | 2                               | P9,PIO   | C,P  |
| IV      | 1                               | P31  | C  |
| V       | 1                               | P25  | T  |
| VI      | 1                               | P22  | UP   |
| VII     | 1                               | P12  | M  |
| VIII    | 1                               | P29  | C  |

Symbols - B= Bihar, C= Chattishgarh, G= Gujrat, H'= Hariyana, M= Maharashtra, P = Punjab, R= Rajasthan, T= Tamil Nadu, UP= Uttar Pradesh.

| TABLE - 2 : Average inter and intra cluster (bold values) genetic divergence(D <sup>2</sup> ) and genetic distance. |                                 |                                 |                                 |                                |                                |                                |                                |                     |
|---|---------------------------------|---------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|---------------------|
| Cluster   | I                               | II                              | III                             | IV                             | V                              | VI                             | VII                            | VIII                |
| I   | <b>41.063</b><br><b>(6.408)</b> | 64.943<br>(8.059)               | 77.317<br>(8.793)               | 57.224<br>(7.565)              | 74.484<br>(8.630)              | 69.389<br>(8.330)              | 72.969<br>(8.542)              | 100.965<br>(10.048) |
| II  |                                 | <b>34.628</b><br><b>(5.884)</b> | 78.897<br>(8.882)               | 103.594<br>(10.178)            | 82.261<br>(9.170)              | 116.44<br>(10.789)             | 61.355<br>(7.833)              | 87.343<br>(9.346)   |
| III   |                                 |                                 | <b>30.575</b><br><b>(5.529)</b> | 83.289<br>(9.126)              | 133.511<br>(11.555)            | 120.297<br>(10.968)            | 95.528<br>(9.774)              | 153.330<br>(12.383) |
| IV  |                                 |                                 |                                 | <b>0.000</b><br><b>(0.000)</b> | 104.663<br>(10.230)            | 45.898<br>(6.775)              | 105.355<br>(10.264)            | 139.243<br>(11.800) |
| V   |                                 |                                 |                                 |                                | <b>0.000</b><br><b>(0.000)</b> | 89.659<br>(9.469)              | 69.324<br>(8.236)              | 49.549<br>(7.039)   |
| VI  |                                 |                                 |                                 |                                |                                | <b>0.000</b><br><b>(0.000)</b> | 117.997<br>(10.863)            | 122.359<br>(11.062) |
| VII   |                                 |                                 |                                 | -                              |                                |                                | <b>0.000</b><br><b>(0.000)</b> | 96.326<br>(9.815)   |
| VIII  |                                 |                                 |                                 |                                |                                |                                |                                | 0.000<br>(0.000)    |
| Values in bold faces are intracluster distances,  |                                 |                                 |                                 |                                |                                |                                |                                |                     |
| Values in parenthesis are statistical distances ( $\sqrt{D^2}$ )  |                                 |                                 |                                 |                                |                                |                                |                                |                     |

| TABLE - 3 : Cluster mean values are different traits among the seed sources of Babul ( <i>Acacia nilotika</i> ) |         |         |         |         |         |        |         |        |            |
|---|---------|---------|---------|---------|---------|--------|---------|--------|------------|
| Characters  | I       | II      | III     | IV      | V       | VI     | VII     | VIII   | Grand Mean |
| No. of branches (2MAG)  | 2.493   | 2.593   | 1.233   | 2.000   | 2.300   | 2.467  | 0.767   | 2.600  | 2.057      |
| No. of branches (16MAG)   | 5.782   | 5.807   | 4.467   | 6.033   | 6.200   | 5.033  | 4.567   | 5.067  | 5.369      |
| Plant Height (cm) IMAG)   | 13.871  | 15.313  | 13.200  | 8.300   | 11.167  | 13.333 | 11.733  | 12.833 | 12.469     |
| Plant Height(cm)(24MAG)   | 113.036 | 111.713 | 123.017 | 113.167 | 126.167 | 90.100 | 167.133 | 95.300 | 117.454    |
| Stem diameter(cm) (2MAG)  | 0.137   | 0.137   | 0.112   | 0.120   | 0.120   | 0.153  | 0.170   | 0.123  | 0.134      |
| Stem diameter(cm) (24MAG)   | 1.200   | 1.221   | 1.307   | 1.223   | 1.307   | 1.063  | 1.704   | 0.943  | 1.246      |
| Seed length (mm)  | 7.958   | 7.673   | 7.933   | 7.900   | 7.200   | 7.400  | 7.533   | 8.033  | 7.704      |
| Seed breadth (mm)   | 6.695   | 6.588   | 6.583   | 6.933   | 6.700   | 6.433  | 6.133   | 6.833  | 6.612      |
| Seed thickness (mm)   | 3.673   | 3.753   | 3.750   | 3.433   | 3.400   | 3.500  | 4.133   | 3.567  | 3.651      |
| 100 seed weight (g)   | 13.804  | 12.300  | 13.167  | 14.500  | 15.500  | 12.333 | 13.167  | 12.500 | 13.409     |
| Leaf protein content%   | 12.223  | 10.188  | 14.158  | 14.753  | 8.877   | 13.487 | 9.940   | 6.860  | 11.311     |
| Bark tannin content(mg/g)   | 20.456  | 12.513  | 7.383   | 24.167  | 29.667  | 31.200 | 25.6    | 19.933 | 21.365     |

sleepers (rail road ties), handle of various kinds of tools. Babul is popular for firewood and charcoal.

Multivariate analysis based on Mahalanobis  $O_2$  statistics and quantification of degree of divergence among provenances population helps the importance of genetic diversity in selecting the genetically diverse parent from various seed sources. The knowledge of genetic divergence is very necessary to classify the plants according to their genetic distance during evaluation. It also helps to select the plant, which are genetically more distant (having much diversity) to make hybridization. Various kinds of studies have been made in Babul, such as provenance variations.

### Materials and Method

Forty provenances (seed sources) were collected from nine states of India. After pre-treatment 150 seeds from each provenance were shown in polybag of 18X12 cm. size having soil mixture containing soil: sand: FYM in ratio 3:2:1 Single seed/polybag were sown in 3 replications. The transplanting was done in salt affected soil of U.P. State spinning mills Rasara, Balia, U.P. Preparation of pit size 2'X2'X2' were dug at the spacing of 4'X5'. Each pit was filled with soil mixture containing soil: gypsum: FYM in the ratio of 2:1:1, 16 month old plants were planted as per treatments. 12 characters *viz*- No. of branches(2MAG), no. of branches (16MAG), plant height (cm.)(IMAG): plant height(24MAG) stem diameter(cm.) (2MAG) stem diameter(cm.) (24MAG) seed length(mm) seed breadth(mm) seed thickness(mm) 100 seed weight (g), leaf protein content (%) and bark tannin content(mg/g) were observed and on the basis of  $D_2$  value. The provenances were grouped into different clusters following the Tocher's. Method<sup>3</sup>. Volumetric observations were recorded at 4,6 and 8 months after transplanting.

### Results and Discussion

All the 40 provenance were grouped into 8 clusters by Tocher's Method (Table-1). The clusters mean for all the 12 characters are presented in (Table-3). Cluster I, was largest included 28 provenances which belonged to different ecogeographical area of India. Of the 28 provenances, 13 belonged to Chattishgarh, 5 to U.P., 2 to each of Maharashtra, Gujarat, Bihar, Rajasthan, One to Haryana and One to Tamil Nadu.

The second (II) cluster included 5 provenances these belonged to Maharashtra, Punjab, U.P. and T.N. The cluster third(III) consisted of only 2

provenances one each Chattishgarh and other to Punjab. Rest of the 5 groups contained single provenances. They were IV Chattishgarh, cluster V Tamil Nadu, cluster VI U.P. , cluster VII Maharashtra and cluster VIII Chattishgarh. The grouping of provenances especially for I, II and III cluster showed that plants of different ecogeographical areas fall in the same group. On the other hand the provenances belonging to similar regions were grouped into different clusters. Thus, there was no relation of geographical area with the genetic divergence.

The inter and intra cluster  $D^2$ -values are given in (Table-2) and the statistical distance between the clusters for all the genotypes are presented in (Table-2). The intra clusters  $D^2$  values are the highest for the cluster I (41.063), followed by cluster 11(34.628) and cluster 111(30.575). Intra clusters distance for others were zero(0). The inter cluster-cluster divergence ( $D^2$ ) was the lowest between the cluster IV and V ( $D^2=45.898$ ) and the highest between the cluster III and VIII ( $D^2=153.330$ ). Cluster I was closest to cluster IV, the statistical distance ( $\sqrt{D^2}$ ) being 7.564 and farthest from cluster VII with the statistical distance of 10.048. Cluster II was closest to cluster VII and farthest from VI, the statistical distance ( $\sqrt{D^2}$ ) being 7.833 and 10.789 respectively. The cluster VIII was closest to cluster V (7.039) and farthest from cluster III. The maximum genetic distance  $\sqrt{D^2}$  was observed between cluster III and cluster VIII (12.383).

Comparison of cluster means for the 12 characters was made and data are presented in Table-3. There was marked inter- clusters variation for all the 12 characters observed. The bark tannin content had the highest average in cluster VI (31.2), followed by the cluster V (29.667), cluster VII (25.6) and cluster IV (24.167). The plants of cluster III showed very poor tannin content (7.383). The cluster I which included 28 provenances had mean tannin content of 20.456, leaf protein content had the highest mean of 14.753% in cluster IV, followed by 14.158% (cluster III). 13.487% cluster VI and 12.233 (cluster I). The 100 seed weight was found to be the highest in the cluster V (15.5g) followed by cluster IV (14.5g) and cluster I (13.804g). The seeds belonging to cluster VII were of the highest thickness (4.133mm) seed breadth was maximum in cluster IV (6.933mm) followed by cluster I (6.695). The seeds of cluster VII had the highest seed length (8.033mm) followed by cluster I (7.958mm) and cluster III (7.933mm). Mean stem diameters at 2 M.A.G. (0.170 cm) and 24 M.A.G. (1.707 cm) were the highest in cluster VII. Plant height was the

highest (15.313 cm) in cluster II and lowest in cluster IV (8.3 cm). At 24 M.A.G. the cluster VII showed maximum mean plant height (167.133 cm) while cluster V, had the smallest plant (90.100 cm) the cluster II (2.593) and cluster VII' (2.6) showed greater number of branches per plant at 2 M.A.G. , but at 16 M.A.G. the mean number of branches of per plant were the highest in the plant cluster V (6.2) as is evident from Table-3.

According to the genetic divergence study,

the seed sources from cluster V, and V may be taken for selection for higher tanning content while the clusters 'V and III should be selected for increased protein content.

The cluster III and VIII showing the highest  $D^2$  value should be taken for hybridization programme. They will produce hybrids showing greater heterosis and better desirable recombinants can be selected in advance generations.

### References

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