International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 10, Issue 11, 2018, pp.-6309-6313.
Available online at https://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

## Research Article

# GROWTH VARIATION AMONG PROGENIES OF *Acacia nilotica* CPTS OF DIFFERENT PROVENANCES

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Received: June 02, 2018; Revised: June 10, 2018; Accepted: June 12, 2018; Published: June 15, 2018

**Abstract:** *Acacia nilotica*, belonging to family Fabaceae, is one of the most important, versatile and multipurpose tree species. Sufficient quantity of quality pods was collected from ten phenotypically superior candidate plus trees (CPTs) from six provenances/geographical locations to test the performance of progeny of individual tree selected. Significant variation was observed in progenies for field emergence, shoot length, root length, fresh seedling weight, numbers of branches per seedling, root-shoot ratio and straightness, open a way to go ahead for further improvement in tree species through selection.

**Keywords:** *shoot length, root length, fresh seedling weight*

**Citation:** Singhdoha Amit, *et al*., (2018) Growth Variation Among Progenies of *Acacia nilotica* Cpts of Different Provenances. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 10, Issue 11, pp.- 6309-6313.

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**Academic Editor / Reviewer:** Dr Vishal Johar

## Introduction

*Acacia nilotica*, belonging to family Fabaceae, is one of the most important, versatile and multipurpose tree species found in dry areas of the Indian sub-continent and Africa. The species seldom occurs above 500 m or in areas with more than annual 1500 mm of rainfall, apart from on harsh porous soils on the river bed sand can grow on a various soil like compact sandy loam, shallow stony, riverine alluvial, black cotton, alluvial loam, saline, mild alkaline, ravines and soils comprising of calcareous concretions. Genetic variation in *Acacia nilotica* has mainly been investigated using morphological and physiological traits. This differentiation is usually pertinent to habitat conditions. Morphological variation is strongly influenced by various environmental factors and morphological variability signifies the adaptation of the species to its environment and it may be genetically determined or environmentally introduced. Thus, morphological differentiation seems to have an evolutionary significance that result in the gradual adaptation of the species to its environment [1][2]. *Acacia nilotica* has wide ecological amplitude and is found growing in a variety of habitats. The species is remarkable variable for various morphological expressions such as leaf, stipular spines morphology, pod and seed characteristics. The population of the species can be differentiated even at a very short distance. The available literature reveals that a little work has been done on growth variation in *Acacia nilotica*. Keeping in view the above facts, the present study was initiated to find extant growth variation in progenies of CPT's of *Acacia nilotica* among different geographical.

## Materials and Methods

A survey was conducted in six geographical locations during June 2014 for collection of *Acacia nilotica* quality pod [Table-1]. Randomly ten phenotypically superior candidate plus trees (CPTs) were selected from each geographical area on the basis traits of economic importance *viz*. clear bole height, straightness, self-pruning ability, low branching habit, disease resistance *etc*., keeping an isolation distance of 200 m having true representation of each geographical area. Adequate amount of quality pods was collected from each selected tree and were kept distinctly in cloth bags for further study purpose. To test the progeny of individual tree selected from six provenances, 300 seeds in three replications were sown in polythene bags filled with equal proportions of sandy soil and FYM.

The experiment was conducted in nursery of Department of Forestry, CCS Haryana agricultural University, Hisar during second week of July 2015. The poly bags soon after seed sowing were irrigated with the help of garden sprinkler and thereafter, proper moisture was maintained as and when considered necessary. The field emergence percentage was observed by counting the number of seeds successfully germinated under each replication. Observations on field emergence were recorded regularly upto 21 days of sowing. Fifteen plants per progeny per replication were selected at random for growth observations. The plant height and collar diameter were recorded at an interval of three months and final observations were recorded at the age of 12 months. Phenotypic, genotypic and environmental coefficients of variation were calculated [3]:

$$\text{Phenotypic coefficient of variation \% (PCV)} = \sqrt{PV}/x \times 100$$

$$\text{Genotypic coefficient of variation \% (GCV)} = \sqrt{GV}/x \times 100$$

x = population mean for each trait

Heritability values and genetic advance were worked out following the methodology of Johnson, *et al*. [4]. Genetic advance (GA) is the estimated increase in the extent of a particular character when a selection pressure of chosen intensity (i) is applied. This was calculated as per Johanson, *et al*. [4].

$$GA = GV/\ PV \times i \times \sqrt{PV}$$

Where, i = selection intensity

## Results and Discussion

Selection exploits the natural variability existing within a population of the chosen tree species. The extent and nature of heritable variation in any tree species could be assessed through progeny testing. The germination and the plant growth characters differed significantly among progeny of CPT's [Table-2]. The germination percentage varied from 25 to78 with the general mean of 46.51. The seed lot from RH7 tree from Hanumangarh provenance showed highest (78%) germination followed by, PF1 (75%) from Firozpur provenance. However, minimum (25%) percent germination was recorded in PR6 from Roopnagar provenance. The collar diameter ranged from 6.61 in PR5 progeny to 10.03 in HS1 (Roopnagar) progeny (Sonipat) at the age of 9 months. Similar variation was observed in collar diameter of different progenies.

Table-1 Geographical information of *Acacia nilotica* provenances

| District | State | Latitude (ºN) | Longitude (ºE) | Altitude (M) | Rainfall (mm) |
|---|---|---|---|---|---|
| Ferozpur | Punjab | 31 | 75 | 197 m | 731 mm |
| Rupnagar | Punjab | 31 | 77 | 262 m | 776 mm |
| Hanumangarh | Rajasthan | 29 | 75 | 181 m | 241 m |
| Sonipat | Haryana | 29 | 77 | 224 m | 653 mm |
| Nagaur | Rajasthan | 27 | 75 | 295 m | 310 mm |
| Dausa | Rajasthan | 27 | 77 | 342 m | 598 mm |

Table-2 Germination and performance of different progenies of *A. nilotica* at different stages of growth in nursery

| Seed source | Germination (%) | Collar diameter (mm) | | | Shoot length (cm) | | |
|---|---|---|---|---|---|---|---|
| | | 3 month | 6 month | 9 month | 3 month | 6 month | 9 month |
| PF1 | 75.00 | 2.11 | 3.35 | 7.28 | 23.36 | 39.72 | 103.38 |
| PF2 | 40.67 | 2.68 | 4.37 | 7.66 | 21.51 | 38.41 | 106.51 |
| PF3 | 56.00 | 1.80 | 4.07 | 6.97 | 19.04 | 34.34 | 85.40 |
| PF4 | 25.67 | 2.24 | 4.27 | 8.09 | 21.17 | 38.94 | 109.71 |
| PF5 | 32.00 | 2.35 | 3.98 | 7.68 | 17.05 | 30.38 | 103.38 |
| PF6 | 52.67 | 2.98 | 4.58 | 7.71 | 19.05 | 35.49 | 109.79 |
| PF7 | 30.00 | 2.74 | 4.38 | 8.03 | 20.87 | 38.35 | 120.51 |
| PF8 | 43.67 | 2.72 | 5.02 | 8.66 | 26.12 | 43.11 | 121.96 |
| PF9 | 31.67 | 2.45 | 4.13 | 7.41 | 22.02 | 34.67 | 105.44 |
| PF10 | 48.00 | 2.90 | 4.82 | 8.90 | 24.26 | 44.77 | 122.52 |
| PR1 | 43.67 | 2.29 | 4.00 | 7.45 | 22.80 | 40.75 | 120.05 |
| PR2 | 39.67 | 2.37 | 3.70 | 7.80 | 22.99 | 33.96 | 90.92 |
| PR3 | 64.00 | 2.39 | 4.49 | 8.35 | 21.76 | 36.55 | 108.45 |
| PR4 | 39.67 | 2.35 | 4.01 | 8.19 | 21.91 | 37.83 | 125.59 |
| PR5 | 50.00 | 2.42 | 3.70 | 6.61 | 21.12 | 30.12 | 86.88 |
| PR6 | 25.00 | 2.25 | 3.59 | 7.44 | 24.54 | 36.64 | 115.84 |
| PR7 | 60.67 | 2.35 | 4.29 | 7.70 | 21.29 | 38.00 | 124.40 |
| PR8 | 50.00 | 2.56 | 4.66 | 8.61 | 20.99 | 35.05 | 109.28 |
| PR9 | 67.67 | 2.12 | 3.86 | 7.21 | 22.53 | 33.84 | 113.44 |
| PR10 | 51.33 | 2.31 | 4.03 | 8.13 | 21.37 | 36.86 | 122.96 |
| HS1 | 57.00 | 3.43 | 5.79 | 10.03 | 26.18 | 46.69 | 140.48 |
| HS2 | 42.00 | 3.19 | 5.21 | 8.20 | 22.57 | 35.91 | 107.81 |
| HS3 | 57.00 | 3.31 | 5.14 | 8.26 | 26.80 | 40.98 | 115.58 |
| HS4 | 48.67 | 3.09 | 4.75 | 8.01 | 23.06 | 34.86 | 112.46 |
| HS5 | 28.33 | 2.79 | 4.57 | 7.41 | 24.94 | 40.47 | 121.47 |
| HS6 | 53.67 | 3.39 | 5.40 | 9.10 | 27.23 | 43.51 | 116.01 |
| HS7 | 55.00 | 2.32 | 4.20 | 7.30 | 18.90 | 38.28 | 100.68 |
| HS8 | 28.67 | 2.68 | 4.65 | 8.24 | 20.08 | 37.21 | 107.01 |
| HS9 | 41.00 | 2.93 | 4.18 | 7.46 | 25.68 | 35.14 | 106.44 |
| HS10 | 43.67 | 3.50 | 5.58 | 8.79 | 25.77 | 45.08 | 122.08 |
| RD1 | 35.67 | 2.71 | 4.55 | 8.35 | 24.95 | 47.31 | 129.31 |
| RD2 | 28.67 | 2.27 | 3.89 | 7.24 | 19.61 | 30.76 | 96.76 |
| RD3 | 27.33 | 2.83 | 4.69 | 8.31 | 25.89 | 40.38 | 122.15 |
| RD4 | 39.33 | 2.99 | 4.67 | 8.60 | 24.22 | 44.42 | 126.19 |
| RD5 | 59.33 | 3.25 | 4.84 | 7.87 | 29.88 | 44.00 | 137.60 |
| RD6 | 42.00 | 2.82 | 4.42 | 8.48 | 25.04 | 43.53 | 138.53 |
| RD7 | 36.67 | 2.84 | 4.63 | 8.52 | 26.90 | 44.73 | 127.23 |
| RD8 | 31.33 | 2.89 | 4.84 | 8.11 | 27.87 | 48.41 | 123.67 |
| RD9 | 29.33 | 2.85 | 4.38 | 8.07 | 29.54 | 43.85 | 123.44 |
| RD10 | 55.33 | 2.49 | 4.22 | 7.95 | 29.44 | 42.21 | 123.23 |
| RN1 | 29.67 | 2.20 | 4.00 | 7.61 | 17.90 | 35.56 | 109.96 |
| RN2 | 59.33 | 2.62 | 4.44 | 8.42 | 22.81 | 38.13 | 109.73 |
| RN3 | 44.33 | 1.97 | 3.76 | 7.57 | 19.21 | 34.66 | 97.16 |
| RN4 | 56.00 | 2.66 | 4.45 | 8.55 | 23.99 | 41.29 | 125.29 |
| RN5 | 48.00 | 2.22 | 4.09 | 7.49 | 20.29 | 37.68 | 118.10 |
| RN6 | 58.00 | 2.53 | 4.14 | 7.96 | 22.45 | 40.00 | 116.80 |
| RN7 | 63.00 | 2.91 | 4.66 | 7.82 | 25.13 | 42.77 | 129.18 |
| RN8 | 27.00 | 2.81 | 4.58 | 8.94 | 25.54 | 42.29 | 128.70 |
| RN9 | 40.00 | 3.13 | 4.89 | 8.19 | 29.85 | 45.48 | 118.68 |
| RN10 | 45.00 | 3.10 | 5.00 | 8.50 | 26.53 | 43.47 | 119.52 |
| RH1 | 60.00 | 2.40 | 4.23 | 8.06 | 20.86 | 37.99 | 110.59 |
| RH2 | 48.33 | 2.90 | 4.65 | 8.49 | 21.85 | 34.96 | 106.18 |
| RH3 | 61.33 | 2.51 | 4.31 | 8.37 | 22.20 | 34.96 | 93.55 |
| RH4 | 46.67 | 2.42 | 4.17 | 9.15 | 22.17 | 38.74 | 102.14 |
| RH5 | 57.00 | 2.35 | 4.13 | 8.39 | 22.07 | 40.46 | 136.86 |
| RH6 | 64.00 | 1.79 | 3.50 | 7.44 | 22.02 | 38.44 | 116.54 |
| RH7 | 78.00 | 2.19 | 3.77 | 7.93 | 22.36 | 39.13 | 113.13 |
| RH8 | 44.00 | 2.53 | 4.38 | 8.95 | 16.94 | 29.90 | 107.30 |
| RH9 | 37.33 | 2.45 | 4.05 | 7.67 | 22.34 | 36.64 | 114.04 |
| RH10 | 56.33 | 3.33 | 5.06 | 9.41 | 28.17 | 42.34 | 113.94 |
| Range | 25.00-78.00 | 1.79-3.50 | 3.35-5.79 | 6.61-10.03 | 16.94-29.88 | 29.9-48.41 | 85.4-140.8 |
| MEAN | 46.51 | 2.63 | 4.40 | 8.08 | 23.25 | 39.00 | 114.87 |
| CD at 5% | 8.80 | 0.40 | 0.78 | 0.84 | 4.78 | 6.64 | 7.51 |

Table-3 Growth performance of different progenies of *A. nilotica* at the age of 12 months in nursery

| Seed source | Shoot length (cm) | Root length (cm) | No. of branches | Straight-ness | Root-shoot ratio | Shoot weight (g) | Root weight (g) | Fresh seedling weight (g) | Dry seedling weight (g) |
|---|---|---|---|---|---|---|---|---|---|
| PF1 | 150.88 | 70.00 | 8.00 | 4.00 | 0.47 | 373.45 | 92.12 | 465.57 | 209.49 |
| PF2 | 156.81 | 82.60 | 10.00 | 3.33 | 0.53 | 325.56 | 100.58 | 426.14 | 217.52 |
| PF3 | 129.40 | 54.90 | 11.67 | 2.83 | 0.42 | 340.56 | 102.79 | 443.35 | 236.00 |
| PF4 | 170.31 | 92.40 | 10.33 | 3.67 | 0.54 | 342.75 | 98.48 | 441.23 | 216.85 |
| PF5 | 150.88 | 66.90 | 8.33 | 4.33 | 0.44 | 318.96 | 92.52 | 411.48 | 202.81 |
| PF6 | 161.87 | 75.90 | 10.00 | 3.50 | 0.47 | 361.52 | 98.43 | 459.95 | 207.94 |
| PF7 | 177.21 | 95.40 | 9.67 | 3.33 | 0.54 | 375.24 | 111.44 | 486.68 | 234.16 |
| PF8 | 179.79 | 102.90 | 8.00 | 4.33 | 0.57 | 425.15 | 90.63 | 515.78 | 242.59 |
| PF9 | 154.54 | 106.50 | 8.33 | 4.00 | 0.69 | 348.56 | 106.66 | 455.22 | 213.41 |
| PF10 | 180.68 | 98.40 | 13.00 | 2.50 | 0.54 | 415.46 | 115.47 | 530.93 | 236.96 |
| PR1 | 182.15 | 107.60 | 9.00 | 4.00 | 0.59 | 360.49 | 114.39 | 474.88 | 240.07 |
| PR2 | 138.72 | 78.20 | 10.00 | 3.33 | 0.56 | 362.40 | 103.06 | 465.46 | 233.46 |
| PR3 | 158.66 | 72.80 | 12.00 | 2.50 | 0.46 | 409.47 | 100.69 | 510.16 | 246.50 |
| PR4 | 182.99 | 87.40 | 10.33 | 3.33 | 0.48 | 359.35 | 95.74 | 455.09 | 229.96 |
| PR5 | 133.18 | 83.00 | 8.00 | 4.17 | 0.62 | 348.59 | 100.71 | 449.30 | 237.60 |
| PR6 | 168.06 | 78.80 | 9.33 | 3.50 | 0.47 | 362.45 | 115.80 | 478.25 | 260.20 |
| PR7 | 182.91 | 84.50 | 10.67 | 3.00 | 0.46 | 405.46 | 100.26 | 505.72 | 243.35 |
| PR8 | 166.96 | 74.70 | 12.67 | 2.33 | 0.45 | 410.45 | 107.20 | 517.65 | 242.13 |
| PR9 | 161.44 | 52.30 | 10.00 | 3.00 | 0.32 | 349.54 | 95.80 | 445.34 | 230.67 |
| PR10 | 170.83 | 59.00 | 10.00 | 2.83 | 0.35 | 413.47 | 100.50 | 513.97 | 248.20 |
| HS1 | 201.28 | 102.40 | 14.00 | 2.17 | 0.51 | 416.53 | 107.62 | 524.15 | 249.16 |
| HS2 | 152.71 | 82.50 | 12.00 | 3.00 | 0.54 | 386.42 | 99.13 | 485.55 | 248.50 |
| HS3 | 173.48 | 66.90 | 11.00 | 3.00 | 0.39 | 378.56 | 102.56 | 481.12 | 222.29 |
| HS4 | 170.36 | 92.50 | 10.00 | 3.17 | 0.54 | 355.66 | 100.19 | 455.85 | 233.94 |
| HS5 | 183.37 | 104.30 | 8.00 | 4.00 | 0.57 | 358.79 | 100.80 | 459.59 | 222.81 |
| HS6 | 173.11 | 76.90 | 13.00 | 2.17 | 0.44 | 424.98 | 110.00 | 534.98 | 266.37 |
| HS7 | 154.58 | 105.50 | 9.00 | 3.67 | 0.68 | 366.64 | 120.12 | 486.76 | 235.70 |
| HS8 | 166.33 | 110.00 | 11.00 | 2.67 | 0.66 | 411.35 | 98.47 | 509.82 | 238.13 |
| HS9 | 165.77 | 92.70 | 14.00 | 1.83 | 0.56 | 385.46 | 103.58 | 489.04 | 234.12 |
| HS10 | 184.38 | 110.50 | 13.00 | 2.50 | 0.60 | 372.47 | 122.41 | 494.88 | 251.80 |
| RD1 | 192.70 | 90.60 | 15.00 | 2.00 | 0.47 | 420.41 | 98.40 | 518.81 | 254.15 |
| RD2 | 146.06 | 74.90 | 13.00 | 2.50 | 0.51 | 422.51 | 101.46 | 523.97 | 247.55 |
| RD3 | 179.15 | 98.80 | 10.33 | 3.67 | 0.55 | 374.28 | 120.48 | 494.76 | 226.05 |
| RD4 | 184.19 | 115.50 | 11.33 | 3.17 | 0.63 | 379.62 | 105.63 | 485.25 | 266.34 |
| RD5 | 202.70 | 129.00 | 10.67 | 3.67 | 0.64 | 378.67 | 106.78 | 548.30 | 275.95 |
| RD6 | 197.63 | 101.90 | 13.00 | 2.83 | 0.52 | 429.67 | 118.63 | 533.71 | 251.38 |
| RD7 | 184.03 | 96.80 | 14.33 | 2.33 | 0.53 | 418.69 | 112.10 | 485.45 | 260.59 |
| RD8 | 180.90 | 114.60 | 9.33 | 3.83 | 0.63 | 365.58 | 114.40 | 479.98 | 233.66 |
| RD9 | 184.24 | 104.00 | 14.33 | 1.83 | 0.56 | 424.68 | 126.55 | 551.23 | 256.77 |
| RD10 | 185.43 | 112.40 | 12.33 | 2.83 | 0.61 | 400.88 | 122.63 | 523.51 | 242.65 |
| RN1 | 158.31 | 70.90 | 9.00 | 4.00 | 0.45 | 374.56 | 103.28 | 477.84 | 238.69 |
| RN2 | 152.53 | 86.60 | 10.33 | 3.67 | 0.57 | 361.46 | 113.56 | 475.02 | 240.28 |
| RN3 | 148.62 | 97.80 | 12.67 | 2.50 | 0.66 | 423.46 | 110.25 | 530.79 | 266.41 |
| RN4 | 178.46 | 98.70 | 9.33 | 4.17 | 0.55 | 359.25 | 98.15 | 457.40 | 220.81 |
| RN5 | 171.26 | 104.60 | 11.00 | 3.00 | 0.61 | 405.69 | 108.60 | 514.29 | 234.48 |
| RN6 | 176.30 | 100.00 | 12.67 | 2.50 | 0.57 | 375.48 | 124.86 | 500.34 | 246.26 |
| RN7 | 185.91 | 106.20 | 14.67 | 2.00 | 0.57 | 408.46 | 106.49 | 514.95 | 258.03 |
| RN8 | 184.38 | 120.00 | 11.33 | 3.00 | 0.65 | 402.94 | 120.15 | 523.09 | 260.71 |
| RN9 | 173.58 | 106.40 | 9.33 | 3.83 | 0.61 | 368.49 | 106.14 | 474.63 | 233.01 |
| RN10 | 177.72 | 87.00 | 15.67 | 1.67 | 0.49 | 422.15 | 101.78 | 523.93 | 261.18 |
| RH1 | 169.76 | 78.30 | 11.33 | 3.00 | 0.46 | 375.56 | 100.18 | 475.74 | 230.61 |
| RH2 | 161.28 | 96.60 | 9.67 | 3.83 | 0.60 | 388.45 | 103.13 | 491.58 | 247.03 |
| RH3 | 148.65 | 98.70 | 11.33 | 3.00 | 0.66 | 365.50 | 115.19 | 480.69 | 230.87 |
| RH4 | 160.57 | 101.00 | 7.67 | 4.50 | 0.63 | 356.29 | 102.34 | 458.63 | 232.13 |
| RH5 | 198.06 | 115.00 | 9.33 | 3.83 | 0.58 | 363.77 | 103.23 | 467.00 | 230.60 |
| RH6 | 177.74 | 89.80 | 9.00 | 4.00 | 0.51 | 419.31 | 116.78 | 536.09 | 263.43 |
| RH7 | 173.80 | 95.70 | 7.67 | 4.67 | 0.55 | 360.40 | 118.30 | 478.70 | 227.60 |
| RH8 | 159.60 | 95.50 | 8.00 | 4.50 | 0.60 | 372.29 | 94.28 | 466.57 | 234.96 |
| RH9 | 165.04 | 78.90 | 10.67 | 3.50 | 0.48 | 369.22 | 99.62 | 468.84 | 234.12 |
| RH10 | 173.74 | 100.80 | 8.00 | 4.50 | 0.58 | 366.74 | 122.14 | 488.88 | 246.40 |
| Range | 129.40-202.70 | 52.30-129.00 | 7.67-15.67 | 1.67-4.67 | 0.32-0.69 | 318.96-429.67 | 90.63-126.55 | 411.48-551.23 | 202.81-275.95 |
| Mean | 170.27 | 92.26 | 10.78 | 3.24 | 0.54 | 382.00 | 106.73 | 488.73 | 239.76 |
| CD at 5% | 7.48 | 1.04 | 3.62 | 1.47 | 0.03 | 8.79 | 6.94 | 12.18 | 24.35 |

Table-4 Magnitude of variation for percent germination and various growth characters of different progenies of *A. nilotica*

| Growth characters | GCV | PCV | Heritability | GA (% mean) |
|---|---|---|---|---|
| Germination (%) | 26.96 | 29.39 | 84.19 | 50.96 |
| Shoot length (cm) | 7.62 | 9.70 | 74.52 | 14.86 |
| Root length (cm) | 12.82 | 17.84 | 70.44 | 25.54 |
| No. of branches per plant | 15.05 | 25.62 | 34.51 | 18.22 |
| Straightness | 17.50 | 33.01 | 28.11 | 19.12 |
| Root-shoot ratio | 9.21 | 15.17 | 58.71 | 17.94 |
| Shoot weight(m) | 4.84 | 7.46 | 61.80 | 9.46 |
| Root weight(m) | 8.18 | 9.11 | 80.63 | 15.13 |
| Fresh seedling weight (m) | 4.35 | 6.52 | 63.41 | 8.50 |
| Dry seedling weight (m) | 4.73 | 9.14 | 26.78 | 5.04 |

Table-5 Phenotypic correlations among percent germination and various growth characters of different progenies of *A. nilotica*

| | Germination | Shoot length | Root length | No. of branches | Straightness | Root-shoot ratio | Shoot weight | Root weight | Fresh seedling weight |
|---|---|---|---|---|---|---|---|---|---|
| Shoot length | -0.04 | | | | | | | | |
| Root length | -0.17* | 0.56** | | | | | | | |
| No. of branches | -0.05 | 0.22** | 0.03 | | | | | | |
| Straightness | 0.06 | 0.24 | 0.06 | -0.94** | | | | | |
| Root-shoot ratio | -0.18* | 0.09 | 0.82** | -0.10 | 0.16* | | | | |
| Shoot weight | 0.03 | 0.38** | 0.15* | 0.46** | -0.43** | -0.05 | | | |
| Root weight | -0.02 | 0.27** | 0.43** | 0.20** | -0.17* | 0.34** | 0.20** | | |
| Fresh seedling weight | 0.02 | 0.42** | 0.27** | 0.47** | -0.44** | 0.06 | 0.95** | 0.48** | |
| Dry seedling weight | 0.006 | 0.21** | 0.19 | 0.29** | -0.27** | 0.03 | 0.49** | 0.24** | 0.51** |

*,** Significant at 5% and 1%, respectively

Table-6 Genotypic correlations among percent germination and various growth characters of different progenies of *A. nilotica*

| | Germination | Shoot length | Root length | No. of branches | Straightness | Root-shoot ratio | Shoot weight | Root weight | Fresh seedling weight |
|---|---|---|---|---|---|---|---|---|---|
| Shoot length | -0.04 | | | | | | | | |
| Root length | -0.19* | 0.56** | | | | | | | |
| No. of branches | -0.06 | 0.37** | 0.05 | | | | | | |
| Straightness | 0.03 | -0.27** | 0.12 | -0.76** | | | | | |
| Root-shoot ratio | -0.22** | 0.07 | 0.84** | -0.18* | 0.31** | | | | |
| Shoot weight | 0.09 | 0.40** | 0.15* | 0.81** | -0.84** | -0.05 | | | |
| Root weight | -0.06 | 0.31** | 0.48** | 0.26** | -0.18* | 0.38** | 0.20** | | |
| Fresh seedling weight | 0.05 | 0.45** | 0.27** | 0.81** | -0.81** | 0.06 | 0.94** | 0.47** | |
| Dry seedling weight | -0.05 | 0.45** | 0.27** | 0.91** | -0.86** | 0.05 | 0.88** | 0.53** | 0.86** |

*,** Significant at 5% and 1%, respectively

Shoot length was largest (140.48 cm) in HS1 from Sonipat provenance, followed by RD5 (137.60 cm) at the age of nine months [Table-2]. In the present study, the progenies of six different provenances of *A. nilotica* at the age of 12 months showed substantial variations in mean performance of growth performance in nursery [Table-3]. The progenies of RD5 from Dausa showed fast growth with higher values for shoot length, root length, root-shoot ratio and straightness. It was closely followed by the progenies of HS1 from Sonipat. Progenies of other selected trees RD1, RD4, RD5, RD6 and RD7 from Dausa provenance, HS1 and HS10 from Sonipat showed desirable growth performance in nursery [Table-3]. Among different provenances under study, the progenies of the selected trees from Dausa provenances showed highest vigorous growth for desirable characters in nursery. It seems that the progenies from Dausa provenance adapted better to the climatic conditions under which they were raised. These findings are in line with the observations of Kedharnath, *et al.* [5], Bagchi, *et al.* [6], Bagchi [7], Bangarwa [8], Sidhu [9], Mishra [10] and Solanki, *et al.* [11].

**Variability, Heritability and Genetic advance**

The values of phenotypic coefficient of variation [Table-4] ranged from 6.25 (Fersh seedling weight) to 33.01 percent (straightness). Overall, the estimate of genotypic coefficient of variation was less in magnitude than the phenotypic coefficient of variation indicating environmental effect on these characters. Heritability estimates in broad sense were observed higher than 50 percent under study (except dry seedling weight, straightness, no. of branches per seedling). The high estimates of heritability help the breeder in the selection programme. Johanson, *et al.* [4] suggested that heritability estimates in conjunction with genetic advance are usually more helpful in predicting its resultant effect for selecting the best individuals. High heritability (broad sense) may be due to non-additive gene action (dominance and epistasis), so it will be reliable only if accompanied high genetic gain. The genetic advance (in percent of mean) ranged from 5.04 (dry seedling weight) to 50.96 (germination) [Table-4]. In present study high heritability coupled with moderate to high genetic advance (% mean) for straightness, root length and germination which indicated that high heritability obtained for these characters was probably due to additive gene effects. High heritability accompanied by moderate to high genetic advance for growth parameters have earlier been reported by Solanki, *et al.* [12] in prosopis cineraria; Gera, *et al.* [13] in Dalbergia sissoo and Dhillon, *et al*. [14] in *Azadirachta indica*.

**Correlation coefficients**

Phenotypic and genotypic correlation coefficients between various seedling characters showed that the magnitude of correlation coefficients at genotypic level was higher than their corresponding correlations at phenotypic level [Table-5] and [Table-6]. This clearly indicated the genotypic association among the characters. Shoot length showed positive correlations with root length, number of branches, shoot weight, root-shoot ratio, fresh seedling weight and dry seedling weight. Such results also have been reported by Thakur and Thakur [15] in *Melia azedarach*. The present observations indicate highly significant variation due to progenies for field emergence, shoot length, root length, fresh seedling weight, numbers of branches per seedling, root-shoot ratio and straightness, open a way to go ahead for further improvement in tree species through selection. Best way for this would be to select enormous amount of seeds from superior trees (through progeny testing) and raise their progenies for second cycle of selection.

**Research Category**: Forestry, Tree Improvement

**Acknowledgement / Funding:** Author thankful to Chaudhary Charan Singh Haryana Agricultural University, Hisar, 125004, Haryana, India

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Research project name or number: PhD Thesis

**Author Contributions: All author equally contributed**

**Author statement:** All authors read, reviewed, agree and approved the final manuscript

**Conflict of Interest: None declared**

**Ethical approval:** This article does not contain any studies with human participants or animals performed by any of the authors.

## References

[1] Mahmood S. and Abbas A. (2003) *Journal of Biological Sciences*, 3, 773-781.
[2] Hussain A. and Mahmood S. (2004) *Journal of Biological Sciences*, 4, 380-385.
[3] Burton G.W. and Devane E.W. (1953) *Agronomy Journal*, 45, 478-481.
[4] Johnson H.W., Robinson H.F. and Comstock R.E. (1955) *Agronomy Journal*, 47, 314-318.
[5] Kedharnath S., Chetty R. and Rawat M.S. (1960) *Indian Forester*, 86, 238-245.
[6] Bagchi S.K., Choubey A.K. and Kulkarni H.D. (1987) *Indian Forester*, 113, 370-374.
[7] Bagchi S.K. (1992) *Indian Forester*, 118(6), 416-424.
[8] Bangarwa K.S. (1993) *Ph.D. Thesis submitted in the Department of Plant Breeding, CCS H.A.U., Hisar*, 165.
[9] Sidhu D.S. (1993) *Indian Forester*, 119,744-752.
[10] Mishra R.N. (1995) *Indian Forester*, 121, 997-1002.
[11] Solanki K.R., Gupta V.K. and Rai P. (1999) *Scientific publishers, Jodhpur*, 325-328.
[12] Solanki K.R., Muthana K.D., Jindal S.K. and Arora G.D. (1984) *Journal of Tree Sciences*, 3, 86-88.
[13] Gera M., Gera N. and Sharma S. (2001) *Indian Forester*, 127, 639-643.
[14] Dhillon R.S., Bisla S.S., Arya S. and Hooda M.S. (2003) *Annals of Forestry*, 11(2), 215-221.
[15] Thakur I.K. and Thakur S. (2015) *Indian Forester*, 141(3), 247-253.