



Original Research Article

**Morphological Variability of Elite Wild Population of Baobab (*Adansonia digitata* L.)
in Aurangabad and Nanded Region of Maharashtra, India**

Ramjan M. Mulani and Mangesh S. Kharate*

DST-FIST and UGC-SAP Sponsored School of Life Science, Swami Ramanand Teerth Marathwada University,
Nanded-431 606, India

*Corresponding author.

Abstract	Keywords
<p>The Baobab (<i>Adansonia digitata</i> L.) is widely distributed throughout Sub-Saharan Africa and India. Information of phenotypic and genetic variation is a prerequisite for the domestication and improvement of baobab fruits from the wild. A study was done to determine variability in seven elite germplasm of baobab populations selected from Aurangabad and Nanded region Maharashtra state in India. Trees and Fruits were characterized from a wide geographical range of area. Morphological traits of trees and fruits were assessed. Results showed high CV % (20) in more than six traits indicating sufficient differences in plant height, number of fruits, length of fruit, number seeds, height and diameter of main stem within the population. Tree number 4 showing better performance for most of traits such as highest height of main stem (26 ft), number of inflorescences/ plants (156), number of fruits / plant (124), length of fruit (27 cm), weight of fruits(184 g), number seeds/fruit (152) and diameter of main stem (3.89 ft). The rich diversity found within populations is important for domestication purposes and tree improvement through selection and breeding. All populations could be used for seed source but distribution should be consciously done recognizing existence of races.</p>	<p><i>Adansonia digitata</i> Variability Wild population</p>

Introduction

Baobab is a large and well known African tree belongs to family Bombacaceae (Wickens, 1982). This is a prime candidate for domestication in the semi-arid regions of Africa (Wickens, 1982). Ecologically, the baobab tree can with stand drought more easily than many annual crops. The fruits are economically important locally, where they can be used as food and medicine, and internationally, where the pulp can be used in the food, pharmaceutical and cosmetic industries (Baum, 1995).

More than 300 uses have been reported for different baobab tree parts in a recent study carried out in West Africa (Dunham et al., 2010). Various parts of the plant are used to treat almost all the diseases. However the documentation endowed with the treatment of diarrhoea, anaemia, dysentery, toothache and body ache (Watt and Breyer-Brandwijk, 1962). Indian people use pulp with buttermilk for control of diarrhoea, dysentery and young leaves for Inflammation purposes. Moreover the dried leaves are used in South Africa for mosquito repellent purposes (Denloye, 2006). The pulp of dried fruit is

reported for control of arthritis disease (De Caluwe et al., 2010). In India and rest of world the parts of the plants are used for nutritional purposes. Also, the *Adansonia digitata* L. fruit has anti-inflammatory and has analgesic of fibrous part. However, little information is available on Baobas from Aurangabad and Nanded region. In these regions, baobab fruit pulp is eaten raw. It is also processed into juice and ice-lollies. Seeds are roasted and eaten. Fruit shells are used as fuel in fish smoking, especially in the lakeshore areas. Fiber from bark is used to make ropes, mats, hats and crafts (Sherry, 1977).

Apart from these local uses, some baobab products are commercialized nationally or internationally and the nationally commercialized products there are baobab seed coffee, baobab seed oil for cooking, baobab juice, baobab jam and baobab fruit pulp powder as well as internationally, baobab fruit pulp powder and baobab seed oil are sold as a food ingredient and for cosmetic use, respectively. Presently, there is scarcity of information on phenotypic and genetic structure of baobabs in southern Africa even though the species is extremely important socially and economically (Gruenwald and Galizia, 2005). Saka et al. (2008) reported significant differences in physico-chemical and nutritional contents between five provenances of baobab fruits in Malawi. However, the patterns and extent of fruit variation existing across populations occurring in varying silvicultural zones in Malawi remain unknown. Knowledge of variation in any species is prerequisite in agroforestry and any tree improvement programme. In present investigation focused on the objective of

evaluation of phenotypic variation existing between and within natural populations growing in different ecological zones based on climatic and edaphic factors.

Materials and methods

Study area

Aurangabad and Nanded region has a sub-tropical climate, with climatic differences more related to altitude than latitude. The climate changes from semi-arid in the Lower Shire Valley, semiarid to sub-humid on the plateaus and sub humid in the high lands. There is a warm-wet season during which 95% of the annual precipitation takes place, a cool dry season and a hot dry season. Humidity ranges from 50% (September-October) to 87% (January-February). Aurangabad and Nanded is one of the most densely populated districts in Maharashtra state, India. The majority of the population relies on agriculture.

Fig. 1: Map of Aurangabad and Nanded districts.

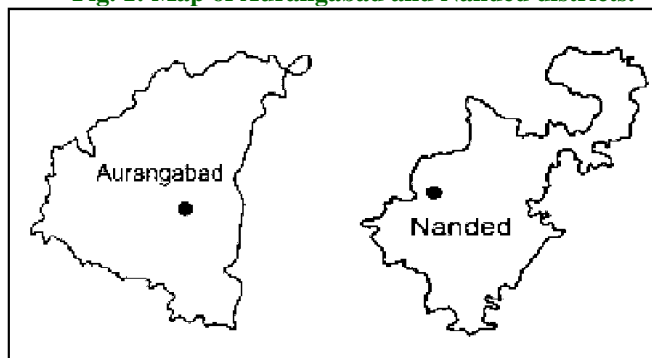


Table 1. Place Name, GPS Location and Code Numbers of Selected Elite Germplasm of *Adansonia digitata* L. from Aurangabad and Nanded Regions of Maharashtra.

Sr. No.	Name of place and address	GPS location of present plant		Code number given to plants
		Latitude °N	Longitude °E	
1	Railway station, Purna, Nanded	19°10'46.44''	77°01'31.85''	01
2	Railway station, Purna, Nanded	19°10'46.44''	77°01'31.85''	02
3	Dr.B.A.M.University, Near Auditorium hall, Aurangabad	19°53'43.71''	75°18'36.18''	03
4	Mr. Rameshwar Raut, A/P Palod, Tal. Sillod, Dist. Aurangabad	20°22'50.07''	75°40'07.78''	04
5	Mr. Bibishan Daruntes Mudhesh Wadgoan, Tal. Gangapur, Dist. Aurangabad	19°42'46.75''	74°56'07.66''	05
6	Mr. Ayub Shaikh Dhakephal, Tal. Paithan Dist. Aurangabad	19°34'22.78''	75°18'15.99''	06
7	Mr. Ayub Shaikh Dhakephal, Tal. Paithan Dist. Aurangabad	19°34'22.78''	75°18'15.99''	07

Distribution of *Adansonia digitata* L.

Information on distribution of baobab (*Adansonia digitata* L.) was gathered from several sources, including unpublished scientific reports, some of the acquired data contained GPS coordinates representing collection sites but others had to be geo-referenced using the Google Earth. In total, 07 geo-referenced baobab presence records were assembled (Table 1) and used for the study. In order to gather information on baobab tree densities, field surveys were conducted. During those, baobab locality data was obtained with a GPS, and baobab density was estimated visually.

Tree assessment, fruit characteristics and data analysis

In total, seven trees used to estimate the height of plant, height of main stem and diameter of main stem by using the measuring tape in feet and the number of inflorescence and number of fruits/plant calculated by visual observation on the tree. The five fruits of these trees were characterized for average length of fruit, average weight of fruits, average weight of seed, average number seed/fruit and average weight of total seed (g)/fruit. The replicated data further utilized for calculation of range, mean and CV for preliminary statistical analysis.

Results and discussion

The baobab tree was found to be lowest distributed in the Marathwada region of Aurangabad and Nanded. Based on the topography and the vegetation of *Adansonia digitata* L. the sampling sites (n=02) are

divided into five arbitrary habitat types, which were described based on the physical characters and the dominance of the vegetation. Generally the sites having high percentage of soil moisture are categorized as moist habitats and those with the low percent of the same as dry habitats. Similarly the sites having stony surfaces and a high percentage of boulders and rock pebbles were considered as rocky habitats. The availability of the species were lowest all the habitats, none of the other surveyed species occurred on all habitat types. However present study shows the least occurrence and its individuals are recorded in all habitat types. This reflects the ecological characteristics and the significance of micro-topographic features for these species. It should be noted that baobab tree distribution is often clumped. In total, more than one individuals per ha were found in sites surveyed. As we estimated maximum distribution, our estimates are not representative of the whole area or district.

Data on morphological traits of *Adansonia digitata* L. had shown that the selected trees varied sufficiently in all traits. Analysis of data for phenotypic traits indicated that the average of height of plant (ft), height of main stem (ft), diameter of main stem (ft), number of inflorescences/ plants and number of fruits / plant were 38.57, 16.28, 2.90, 129.14, 86.42, 21.65, 160.57, 0.56 and 107.00 with the range of 28-50, 12-26, 1.88-3.76, 89-156, 67-124, 14-27, 146-184, 0.42-0.72 and 44-152 respectively (Table 2). The findings are important because they suggest the potential of achieving high genetic gains through classical tree breeding and through vegetative propagation. The results support the assertion that use of clones in fruit trees might increase productivity rapidly (Akinnifesi et al., 2008).

Table 2. Mean, range and coefficient of variation for Morphological traits in *Adansonia digitata* L.

Sr. No.	Growth parameters	Range	Mean	CV (%)
1	Height of plant (ft)	28-50	38.57	20.24
2	Height of main stem(ft)	12-26	16.28	28.96
3	Diameter of main stem (ft)	1.88-3.76	2.90	26.62
4	Number of inflorescences/ plants	89-156	129.14	18.61
5	Number of fruits / plant	67-124	86.42	23.76
6	Length of fruit (cm)	14-27	21.65	22.32
7	Weight of fruits(g)	146-184	160.57	8.94
8	Weight of seed (g)/fruit	0.42-0.72	0.56	19.99
9	Number seeds/fruit	44-152	107.00	34.51

The fruit characteristics among the all selected trees such as length of fruit (cm) was ranges from 14-27 with a mean value of 21.65, weight of fruits (g) ranged from

146-184 with a mean value of 160.57, weight of seed (g)/fruit ranged from 0.42-0.72 with a mean value of 0.56 and number of seeds/fruit ranged from 44-152 with

a mean value of 107.00 (Table 2). Earlier many scientists reported variation in fruit length of 20 to 30 cm (Mwase, et al., 2006). Barwick (2004) also reported fruit length up to 30 cm. In the present investigation, highest CV% (34.51) was observed in numbers of seeds/fruits. Among the all studied nine traits, six traits showed CV more than 20% indicating sufficient variation is present in selected germplasm (Table 2).

The presence of high coefficient of variation (CV= 34.51 %) indicates the presence of high environmental impact where as low values (CV=8.94) could be an indication of strong genetic control (Mwase et al., 2006). In the case of our study, fruit weight and seed weight had high environmental influence. In present study

identified the plant number 4 which was recorded highest height of main stem (ft.), number of inflorescences/ plants, number of fruits / plant, length of fruit (cm), weight of fruits(g), number seeds/fruit and diameter of main stem (ft.) (Figs. 1, 2 and 3). Thus, quantitative traits require classical breeding to achieve high genetic gains (Zobel and Talbert, 1984). The diversity of fruit sizes found in this study has unveiled high polymorphism existing in populations of baobabs in the country and recently all the forms of fruits of baobab described by many researchers in the world (De Smedt et al., 2011). Our results compare favorably with several published literature on baobab phenotypic variations (Barwick, 2004; De Smedt et al., 2011; Nour et al., 1980).

Fig. 1: The plant height, height of main stem (primary axis) and diameter of main stem (secondary axis) in *Adansonia digitata* L. during August 2014.

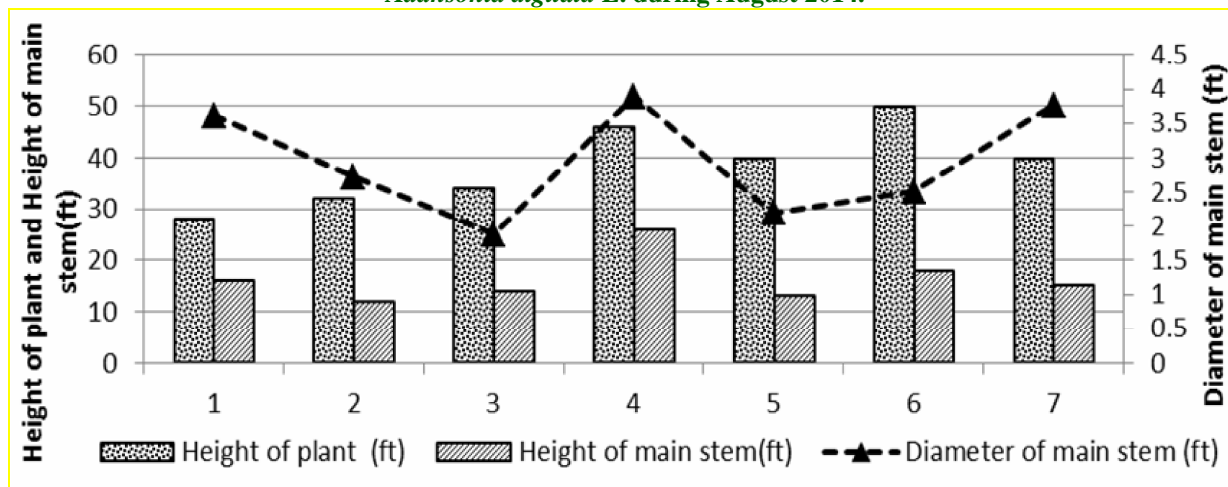


Fig. 2: The number of inflorescences, number of fruits/ plant (primary axis) and average length of fruits (secondary axis) in *Adansonia digitata* L. during August 2014.

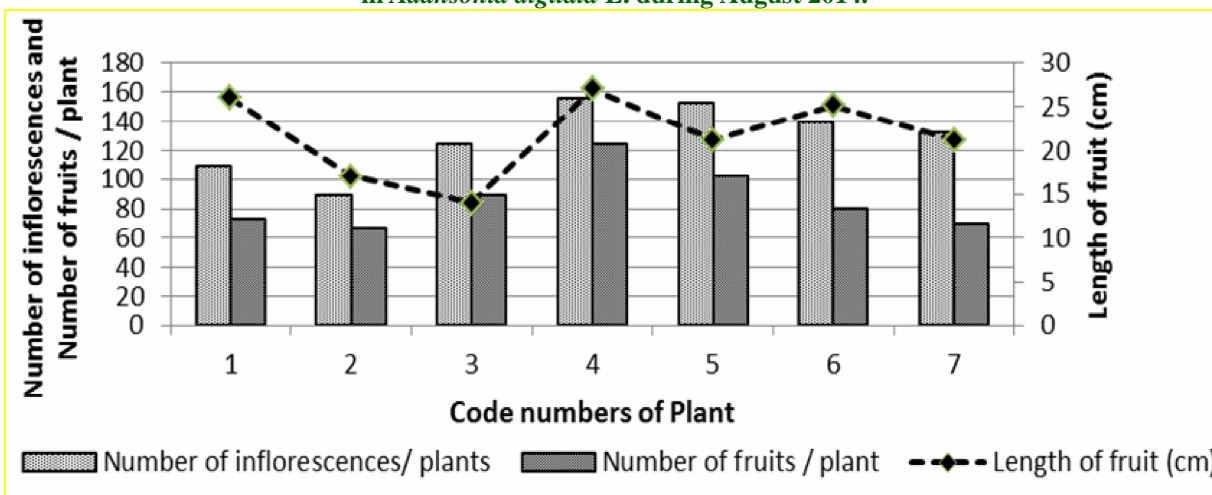
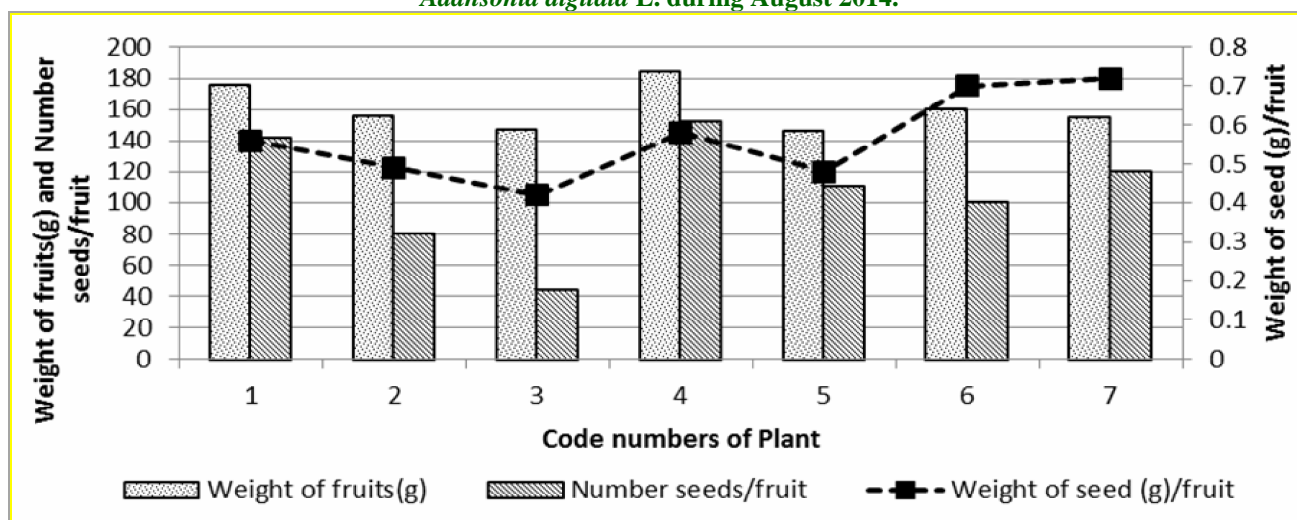


Fig. 3: Average weight of fruits, number of seeds/ fruit (primary axis) and average weight of seed/fruit (secondary axis) in *Adansonia digitata* L. during August 2014.



Conclusion

Primary investigation of selected trees were distinguished and described through visual examination seven trees and thirty-five fruits. Tree number 4 showing better performance for the most of important characteristics, which is related to fruits and plant structure. Therefore this study is a first step in fulfilling the criteria of different fruits in terms of size and shape of baobab tree. It will help in the assessment of variability which will facilitate selection or breeding for better quality, higher yielding cultivars, germplasm characterization and exchange. This may help to protect the species needs, to screen more material to get super-trees as well as enhance the food supply and income generation for the rural peoples.

References

- Akinnifesi, F.K., Sileshi, G., Ajayi, O.C., Chirwa, P.W., Kwesiga, F.R., Harawa, R., 2008. Contribution of agroforestry research and development to livelihood of smallholder farmers in Southern Africa: 2. Fruit, medicinal, fuel wood and fodder tree systems. *Agric. J.* 3(1), 76-88.
- Barwick, M., 2004. *Tropical and Subtropical Trees: A Worldwide Eyclopaedic Guide*. Thames and Hudson, London, UK.
- Baum, H.G., 1995. The comparative pollination and floral biology of baobabs (*Adansonia-Bombacaceae*). *Ann. Missouri Bot. Gard.* 82, 322-348.
- De Caluwe, E., Halamova, K., Van Damme, P., 2010. *Adansonia digitata* L. - a review of traditional uses, phytochemistry and pharmacology. *Afrika Focus* 23, 11-51.
- De Smedt, S., Alaerts, K., Kouyate, A.M., Damme Van, P., Potters, G., Samson, R., 2011. Phenotypic variation of baobab (*Adansonia digitata* L.) fruit traits in Mali. *Agrofor. Syst.* 82, 87-97.
- Denloye, A.A.B., Teslim, K.O., Fasasi, O.A., 2006. Insecticidal and repellency effects of smoke from plant pellets with or without D-allethrin 90 EC against three medical insects. *J. Entomol.* 3, 9-15.
- Dunham, K.M.E., Van der Westhuizen, H.F. Van der Westhuizen, Gandiwa, E., 2010. *Aerial Survey of Elephants and Other Large Herbivores in Gonarezhou National Park (Zimbabwe). Zinave National Park (Mozambique) and Surrounds: 2009*. Parks and Wildlife Management Authority, Harare.
- Gruenwald, J., Galizia, M.D., 2005. Market brief in the European Union for selected natural ingredients derived from native species. *Adansonia digitata* L. Baobab. The United Nations Conference on Trade and Development (UNCTAD). Bio Trade Initiative/BioTrade Facilitation Programme (BTFP).
- Mwase, W.F., Bjornstad, A., Ntupanyama, M.B., Kwapata, Bokosi, J.M., 2006. Phenotypic variation in fruit, seed and seedling traits of nine Uapaka Y. M. kirkiana provenances found in Malawi. *South. Afr. For. J.* 208, 15-21.
- Nour, A., Magboul, B.I., Kheir, N.H., 1980. Chemical composition of baobab fruit (*Adansonia digitata* L.). *Trop. Sci.* 22(4), 383-388.

- Saka, J.D.K., Kadzere, I., Ndabikunze, B.K., Akinnifesi, F.K., Tiisekwa, B.P.M., 2008. Product Development: Nutritional Value, Processing and Utilization of Indigenous Fruits from the Miombo Ecosystem. In: Indigenous Fruit Trees in the Tropics Domestication, Utilization and Commercialization (Eds.: Akinnifesi, F.K., Leaky, R.R.B., Ajayi, O.C., Silesh, G., Tchoundjeu, Z., Matakala, P., Kwesiga, F.R.). Columns Design Ltd, Reading, UK.
- Sherry, B.Y., 1977. Basic Vegetation Types of the Gonarezhou National Park, Zimbabwe. Project No. GNP/3Y/2. Department National Parks and Wildlife Management, Harare.
- Watt, J.M., Breyer-Brandwijk, M.G., 1962. The Medicinal and Poisonous Plants of Southern and Eastern Africa. 2nd Edn. E and S. Livingstone, Edinburgh.
- Wickens, G.E., 1982. The baobab - Africa's upside-down tree. *Kew Bull.* 37, 173-209.
- Zobel, B., Talbert, J., 1984. Applied Forest Tree Improvement. John Wiley and Sons Inc., New York.