

## **MORPHOLOGICAL VARIATION IN FRUITS AND SEEDS OF *BALANITES ROXBURGHII* PLANCH (HINGOTA) IN SEMI-ARID REGION OF RAJASTHAN**

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### **ABSTRACT**

*Balanites roxburghii* Planch locally known as Hingota, a native of India and Pakistan is underutilized wild tree of arid areas, however have also several medicinal uses since ages. The fruit contain saponin and therefore locally used to wash clothes. Its seed has also great potential to provide feedstock for biodiesel production. A preliminary survey was conducted to investigate morphological variation among fruits and seeds. The fruits were collected from 3 different locations of Pali-Marwar region (Khathi khera, RRS Pali farm and RMSE area). Fruit morphological characteristics were recorded followed by soaking in water for 7 days to extract seeds. High variation was observed between trees as well within tree for shape, size, colour and weight of fruits and seeds. Three different types of shape in fruits (elliptic, ovoid and spherical) and seeds (elliptic, oblong and spherical) were observed. Fruit did not show colour variation, however, seed colour ranged from yellowish to dark brown. The fruit length, fruit width and fruit weight varied from 3.4 cm to 5.5 cm, 2.9 cm to 4.5 cm and 16 to 40 g respectively, while seed length, width and weight varied from 2.9 cm to 4.7 cm, 1.9 cm to 3.1 cm and 8.3 to 19.93 g respectively. Highest coefficient of variation was found in length (18.3 for fruits and 21.7 for seeds) as well as weight (23.54 for fruits and 24.48 for seeds) of fruits and seeds collected from different trees, however, it was highest for only weight of fruits and seeds (17.76-19.44 for fruits and 13.59-20.91 for nuts) collected from same trees, indicating variation between trees. It is concluded that, there is considerable variation in fruit and seed of hingota offering opportunities for selection there by spreading more scope for conservation and utilization.

**Key words:** Balanites, Coefficient of Variation, fruits and seeds, Conservation and utilization

### **INTRODUCTION**

*Balanites roxburghii* Planch belonging to the family, Zygophyllaceae known as hingota, Soap berry tree/ thorn tree/ desert date is an important genus of thorny shrubs or trees distributed in dry regions of India. It is particularly found in Rajasthan, Gujarat, Madhya Pradesh and Deccan. It is found in many kinds of habitat, tolerating a wide variety of soil types, from sand to heavy clay and climatic moisture levels (Chothani &

Vaghasiya, 2011). The Indian tribes use the pulp of the fruit as a detergent and substitute for soap. In African countries, ripe fruits are eaten raw or sun dried and stored like dates. The seeds are bitter in taste and therefore debittered seeds are possibly be marketed as salted or roasted nuts. Young shoots and leaves are used as vegetable, added to soups, melon seeds/peanut pastes and used as a relish (Tewari, 2016). The fleshy pulp of the fruit contains a large amount of

carbohydrates. The fresh/dried leaves are eaten by livestock. The tree is lopped for fodder in India [(Maharashtra, Madhya Pradesh, Tamil Nadu and Rajasthan) (Orwa *et al.*, 2009)]. The roots and fruits of this plant contain diosgenin, which is used in production of oral contraceptive, sex hormone and anabolic steroids. Kernel oil content may reach up to 46.7% (based on dry weight) and successfully tested for biodiesel production (Chapagain *et al.*, 2009). Linoleic acid was found to be the most prevalent fatty acid, ranging from 31% to 51% of the fatty acids profile necessary for biodiesel production. Apart from this, the plant has got a wide range of adaptability, which makes it very important species for afforestation in desert and barren land. It can withstand flood for two months (IPGRI, 1984). It can tolerate Na<sup>+</sup> concentration up to 3840 ppm in soil (Firmin, 1971). The plant starts to produce fruit after 5-7 years (Gour & Kant, 2012). Finest of the trees can yield date fruits up to 52 kg/trees (Chapagain *et al.*, 2009).

Despite multiple uses, it is considered as one of the underutilized, neglected arid zone tree species. The existence of phenotypic variation within and among natural populations is important for tree domestication programs since it is the base for selection and improvement (Simons & Leakey, 2004). Knowledge of fruit and seed parameter is very essential to identify fruits and seeds, to design or adapt processing procedure and to quantify the extent of genetic and environment effect. The genetic inheritance carried by seeds makes up the potential performance of the progeny and poor genetic potential will result in poor performance, regardless of environment or silvicultural treatment

(Schmidt, 2000). With this background, a preliminary survey was carried out in 2016, to investigate the variation in fruit and seed morphological parameters at Pali–Marwar region, Rajasthan (RJ), India in three different locations with similar climatic and soil conditions (Table 1).

## MATERIAL & METHODS

Hingota trees found in natural populations were chosen for the study. Trees in three locations were chosen based on comparison/check tree method using morphological features like height, diameter and free from pest and diseases. The selected trees are called ‘Candidate plus tree’ (CPT’S) (Zobel & Talbert, 1984). Height and diameter of CPTS were measured by altimeter and measuring tape. A total of three candidate plus trees, one from each location were selected and twenty five fruits were collected from each trees for measuring following traits viz., variation in shape, colour, size, fruit length (cm), fruit width (cm) and fruit weight (g). After measuring fruit parameters, it was soaked in water for 7 days for extraction of seeds. The pulp was washed and seeds were dried in shade. Seed parameters viz., seed length (cm), seed breadth (cm) were measured using Vernier calliper and seed weight (g) by electronic balance. Latitude and longitude detail are given in Table 1. Three locations were named as BR 1, BR 2 and BR 3 [where BR indicates *Balanites roxburghii* Planch].

## RESULTS & DISCUSSION

The average height and DBH (Diameter at Breast Height) of CPT’S ranged from 3 to 4 m and 11 to 12 cm respectively. Results showed that there was

significant variation in fruit and seed traits (shape, size, and colour) among trees and within trees (Table 2). The fruits were observed in three different types of shapes i.e., elliptic, ovoid and spherical, however, fruit colour (brown) did not show any variation. The fruit length, fruit diameter and fruit weight varied from 3.4 cm to 5.5 cm, 2.9 cm to 4.5 cm and 16 to 40 g respectively. The maximum fruit trait was recorded from BR 2 (4.81 cm for fruit length, 3.90 cm for fruit diameter and 31.25 g for fruit weight). Kala & Dubey, 2014 has reported similar result for fruit length (3.6 cm to 5.8 cm) but difference in fruit shape, fruit diameter and fruit weight of *Balanites aegyptiaca* (L.) Delile. They observed oblong, round, spheroidal and tapered oblong type of shape, lower fruit diameter 18.7 to 28.5 mm and fruit weight 5.5 to 10.5 g. This variation might be due to variation in climatic conditions as the present study was under semi-arid condition whereas Kala & Dubey (2014) reported study in humid subtropical climatic condition of Agra, India. Abasse *et al.* (2011) studied variation in fruit and seed morphology in semi-arid Niger; they reported that the drier parts of the sample region tended to have heavier fruits and kernels, longer/narrower seeds.

Under seed parameters, the seed length, diameter and weight varied from 2.9 cm to 4.7 cm, 1.9 cm to 3.1 cm and 8.3 to 19.93 g respectively. Similarly, seed diameter (2.88 cm) and seed weight (16.93g) recorded maximum from BR 2 whereas BR-3 recorded minimum for all seed traits (seed length 2.90 cm, seed diameter 2.50 cm and weight 10.67 g). The seed colour ranged from yellowish to dark brown (Table 2 and Figure1). Elfeel & Warag (2006) also reported

similar seed length (2.30 cm to 3.66 cm) and seed diameter (1.72 to 2.30 cm) among eleven *B. aegyptiaca* geographical seed sources from Sudan in seed morphological parameters.

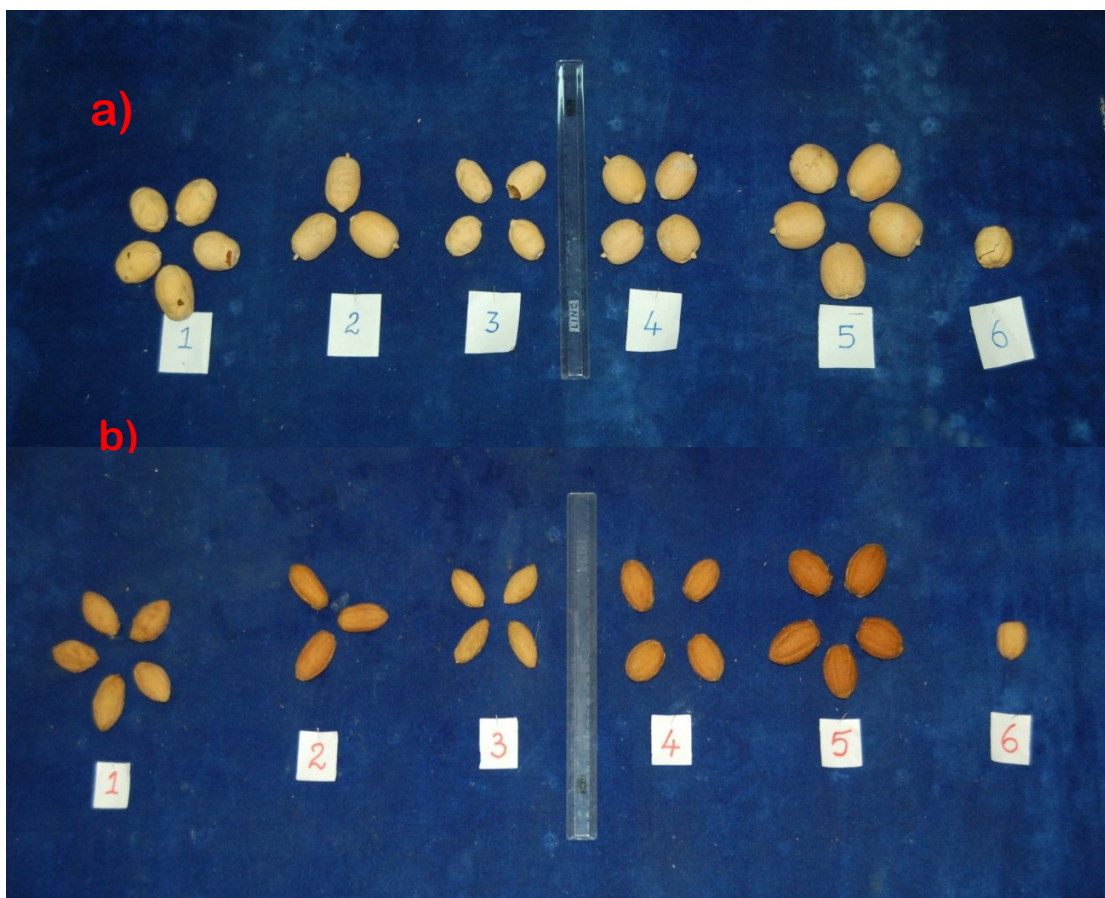
Genetic improvements of woody tree species are constrained by several factors such as the large size and long life cycle, self-incompatibility and high level of heterozygosity (Khamis *et al.*, 2016). In the present study, highest coefficient of variation (CV) was found in length (18.3% for fruits and 21.7% for seeds) as well as weight (23.54% for fruits and 24.48 % for seeds) of fruits and seeds collected from different trees, however, CV was highest for only weight of fruits and seeds (17.76-19.44 for fruits and 13.59-20.91 for nuts) collected from same trees, indicating high variation between trees as compared to within trees. The variation in fruit and seed diameter was low as compared to length and diameter. Abasse *et al.* (2011) also reported lower within-tree variability in fruit and seed width with similar coefficient variation in fruit length (13.81%) and weight (26.23%) of *B. aegyptiaca* collected from trees in four natural populations of Niger, West African Sahel. Variation in fruit and seed parameters has already been reported in other species also by Sharma *et al.* (1994) in *Prosopis juliflora* (Sw.) DC, Meena *et al.* (2015) in *Tecomella undulata* D.Don, Raut *et al.* (2011) in *Pongamia pinnata* (L.), Pierre, *et al.* and Sharma & Kumar (2013) in *Jatropha curcas* L.

## CONCLUSION

Documentation of natural variation will offer opportunities for selection of superior attributes from within and between natural populations, thereby

spreading more scope for conservation and utilization. The present study highlights the morphological variation in a relatively small geographical area which is essential for conservation programs and also for afforestation of

arid and semi-arid regions. Further studies are warranted to estimate genetic variation and its interaction among different environments, which will enhance the scope in further tree improvement programme.



a) and b) Label 1,2 and 3 from Khatikera; 4 and 5 from Pali farm; 6 from Rangeland Management and soil conservation Engineering area (RMSE)

**Figure 1: Variation with in and among trees of *Balanites roxburghii* Planch for fruit and seed traits**

**Table 1: Latitude and longitude of Candidate plus Tree (CPT'S) collected from Pali Marwar Region**

Location	Latitude	Longitude	Candidate Plus tree	
			Height (m)	DBH <sup>a</sup> (cm)
Khati kera, BR <sup>b</sup> 1	25° 42' 25.24" N	73° 26' 48.66" E	3.50	12.10
Pali farm BR <sup>b</sup> 2	25° 48' 26.93" N	73° 17' 27.64" E	3.20	9.00
RMSE <sup>c</sup> area, Pali BR <sup>b</sup> 3	25° 48' 48.31" N	73° 18' 5.58" E	3.40	12.10

<sup>a</sup>DBH - Diameter at Breast Height

<sup>b</sup>BR - *Balanites roxburghii* Planch

<sup>c</sup>RMSE - Rangeland Management and Soil Conservation Engineering

**Table 2: Variation in fruit traits of *Balanites roxburghii* Planch**

Location	Fruit traits						Fruit Shape
	Fruit Length (cm)		Fruit Diameter (cm)		Fruit Weight (g)		
	Mean + SD	CV (%)	Mean + SD	CV (%)	Mean + SD	CV (%)	
<sup>a</sup> BR 1	4.72 ± 0.37	7.82	3.38 ± 0.29	8.53	23.00 ± 4.47	19.44	elliptic
<sup>a</sup> BR 2	4.81 ± 0.45	9.32	3.90 ± 0.55	14.18	31.25 ± 5.55	17.76	ovoid
<sup>a</sup> BR 3	3.40 ± 0.41	9.12	3.50 ± 0.36	10.42	20.00 ± 5.81	18.23	spherical
Mean	4.31		3.59		24.75		
Standard error of difference (SEd)	0.79		0.27		5.83		
Critical difference (CD)	1.18		0.93		3.38		
Coefficient of variation (CV %)	18.31		7.54		23.54		

<sup>a</sup>BR- *Balanites roxburghii* Planch

**Table 3: Variation in seed traits of *Balanites roxburghii* Planch**

Location	Seed traits						
	Seed Length (cm)		Seed Diameter (cm)		Seed Weight (g)		Colour
	Mean + SD	CV (%)	Mean + SD	CV (%)	Mean + SD	CV (%)	
<sup>a</sup> BR 1	4.44 ± 0.16	3.65	2.38 ± 0.25	10.64	12.26 ± 2.56	20.91	Yellowish brown
<sup>a</sup> BR 2	4.24 ± 0.21	4.88	2.88 ± 0.15	5.18	16.93 ± 2.33	13.59	Dark brown
<sup>a</sup> BR 3	2.90 ± 0.20	4.29	2.50 ± 0.21	7.46	10.67 ± 2.45	14.78	Yellowish
Mean	3.86		2.58		13.28		
Standard error of difference (SEd)	0.84		0.26		3.25		
Critical difference (CD)	1.29		0.74		0.55		
Coefficient of variation (CV %)	21.70		10.07		24.48		

<sup>a</sup>BR- *Balanites roxburghii* Planch

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