Morphological Variation in Balanites aegyptica Seed of Seven Provenances from Sudan

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ملخص الدراسة:
الهدف من هذه الدراسة هو معرفة الخصائص والفروقات المعنوية بين بذرة الهجليج من مناطق جغرافية مختلفة في السودان تشمل (الفاشر، الجنينة، الدندر، الدمازين، القضارف، كادقلى، كبوشية)، وذلك لمعرفة الأثر البيئي والوراثي على تلك البذور بغرض الجودة الوراثية واستغلالها. جمعت البذورالخالية من العيوب في موسمي 2012- 2013م، واخضعت البذور لعمليات قياس طول البذرة، القطر ووزن البذرة والجنين، وايجاد معامل الشكل والحجم ثم تحليلها وإظهار النتائج.
أثبتت الدراسة النتائج التالية: أن هنالك فروقات معنوية عالية في الشكل الظاهري، حيث أوضح التحليل لمجموعتين، المجموعة الأولى تمثل المناطق ذات الأمطار الغزيرة والتربة الطينية، والمجموعة الثانية تمثل المناطق ذات التربة الرملية والأمطار الخفيفة، وقد أثبتت المجموعة الأولى الصدارة في كل الصفات المقاسة، علماً بأن المجموعة الأولى تقع في المرتبة الثانية مقارنة بالمجموعة الثانية. واستنتجت الدراسة أن هنالك آثاراً واضحة للمواقع الجغرافية المختلفة في الصفات الظاهرية، مما يؤدى إلى التحسين في برامج النسل لشجرة الهجليج.

Abstract:
The objective of this study was to investigate the morphological variation of seven Balanites aegyptiaca seed sources from different parts of Sudan. Healthy mature uncrushed fruits of Balanites aegyptiaca were collected during the period 2012-2013 season. The seeds sources included. Elfasher, Elgenaina, Eldinder, Eddmazain, Elgadaref, Kadogly and Kuboshia, Table (1). Seeds characteristics investigated included seeds length, weight, diameter, shape and size.Two hundred seed, five samples, fifty each were randomly chosen from each provenance. Measurements were taken from 50 seeds for each variable per provenance making a lot of 250 seeds/provenance. Results show highly significant differences between provenances in all morphometric characteristics investigated as shown in Table (2). Analysis of variance showed two distinct group of provenances. The first group consisted of Elgadaref, Eldinder, Kadogly and Eddamazain while the second group pieced together in Elfasher, Elgenaina, and Kuboshia. The first group represent provenance from areas of higher rainfall and clay soils whereas the second group represent mostly sandy soil with low rainfall. Generally the first group ranked top approximately in all measured characteristics investigated, while second group ranked significantly lower compared to the first group. The study concluded that there were tangible effects of geographical location in terms of morphometric characteristics differences that can effectively use in breeding and improvement programs of Balanites aegyptiaca.

Key words: Balanites aegyptiaca, provenances, seeds, morphological parameters

Introduction:

Balanites aegyptiaca (Heglig) is valuable tree species particularly in the dry season in rural areas. Ecologically Balanitesaegyptiaca is considered as resilient species and highly versatile towards sahelain soils and climatic conditions (Parkan, 1993, Hiemaux et al, 2006). It has a wide ecological distribution in dry lands of Africa, (Hall et al, 1991; Sand 2001). Balanites aegyptiaca is an indigenous tree species to Sudan with a wide range of natural occurrences over diverse climatic and edaphic conditions (Suliman and Jackson, 1959). Its traditional roles and values were well known for thousands of years as fruits were found in tombs of 12th Egyptain dynasty (Von Maydell, 1986). The tree is used for food and fodder and as agroforestry tree (ICRAF, 1998). Knowledge of fruits and seeds characteristics are very important to identify fruits and seed, to design or adapt processing procedure and to quantify the extend of genetic and environmental effects. The genetic inheritance carried by seed makes up the genetic potential performance of the progeny and poor potential will result in poor performance, regardless of environmental or silivcultural treatment (Schmidt, 2000).Many authors have reported a great genetic variation on seed of tropical tree species such as Acacia Senegal (Elfeel and Warag, 2002); Acacia nilotica (Chhillar et al,2002;Elfeel and Warag, 2006), who studied the variation among eleven Balanites aegyptiaca geographical seed sources in seed morphology reporting a great variation among different seed sources on seed length, seed diameters, size index and shape index ratio. There were significant differences between the four fruit shapes (oblong, elongate, spherical and oval fruits) in all of the studied morphological characteristics across and within sites and between locations. Fruit weight had the greatest variation among all fruit characteristics and fruit diameter showed the least degree of variation (Abdoun Somaya Omer et al,1985).The tree produces about 125 kg of ripe fruits, that looks like palm fruits in size and appearance (Ecky, 1984). Length ranges between 2.5-4 cm and diameter range between 1.5-2.5 cm in (Thirakul 1984; Von Mydell 1986 and Sahni 1968). The study aimed to investigate variation of seed morphometric characteristics between the provenances across the country to exploit this variation in future breeding programs and improvement.

Materials and methods:

Seeds sources:

Seven geographical seeds sources were selected for the collection of seeds. The selected locationscovered the most parts of the country with its known variable ecological characters. Details of provenances used were depicted in Table (1).

Table (1) Details of seven provenances of Balanitesm aegyptiaca used in the study

Provenance	Longitude	Latitude	altitude (m)	Soil type	AverageRainfall (mm)	AverageTemp.
Elfasher	250 20' E	130 38' N	700	Sandy	318.20	35
Elgadaref	350 24' E	140 02'N	58	Vertsol	662.35	38
Kadogly	290 43' E	110 00'N	499	Cracking	673.90	40

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Eddamazain	340 24' E	110 49'N	492	Vertsol	802.68	42
Elgenaina	220 27' E	130 29'N	800	Sandy loami	464.3	38
Eldinder	340 25' E	340 4' 0'N	427	Clay	756.82	39
Kuboshia	310 35' E	160 42' N	354	Sandy	158.00	38.1

Meteorological Authority, Ministry of Environment, Forestry, Physical Planning and development 2013.

Seed collection:

The seeds were collected during the period November- December 2012- 2013 according to the fruiting season. The collection was done from seven provenances Table (1).Mature and healthy fruits were collected from trees crowns by shaking them with long hooked stick to facilitate the safety dropping of fruits beneath the tree without shattering them, where the plastic sheets were already stretched under the tree before the operation. Sound fruits of Balanites aegyptiaca had been collected from 20- 30 trees 100- 200 meters apart from each other in the seven targeted geographical locations. The mature dry fruits collected were safely kept in plastic sacks with good ventilation to prevent them to rot.

Seed extraction and cleaning:

The collected seeds were extracted by soaking the fruit pulp in water for a period of 48 hours, washed twice and sundried for 24 hours, then empty seeds, debris and shaft were discarded.

Sampling and measurements:

Fifty seeds were randomly selected from each provenance seed/lot for each measurement. A lot of 250 seeds were used. The parameters measured covered the seed weight, length, diameters, size and shape using tools such as ruler, venire and sensitive balance, beside a formula for determination of size and shape. Seed size = (length x diameter). Seed shape = (length divided by diameter). The data were collected and analyzed using (SAS) statistical Analysis Package.

Results and discussion:

The effect of locations on seed morphological characters:

Analysis of variance (ANOVA) showed highly significant differences in all morphological parameters tested between all provenances at ($p \geq 0.0001$), Table (2) & (3).

Seed weight:

The weight of seed showed very high significant difference between provenances at ($p \geq 0.05$), where heaviest weight was recorded in Elgadaref (8.44) mg/100g followed by Eldindder (7.89), mg/100g Kadogly (6.49), mg/100g Eddamazain (6.44), mg/100g. These provenances characterized by cracking clay soil and rainfall between (462 and 680)mm/annum, this was similar to Abdoun Somaya Omer et al 1985 who found higher weight in Eldinder provenance, and lowest value recorded in Kuboshia

provenance, Kuboshia provenance lies in desert areas which characterized by sandy soil and low rainfall which is about 158 mm/annum.

Seeds length:

Showed significant difference between provenances, highest value recorded in Eddamazain , Elgadaref, Kadogly and Eldinder (3.67), (3.61), (3.42), and (3.33) cm respectively and low value was recorded in Kuboshia and Elfasher (3.14), (3.16) cm these two provenances characterized by sandy soil and low rainfall range between (158 and 232) cm.This agreed with the finding of Elfeel and Warag 2006. Table (2) and (3).

Seeds diameter:

Showed significant difference between provenances, where high value recorded in Kadogly (2.26) cm and Elgadaref revealed the second rank (1.89) cm however there is no significant difference in parameters diameter Between Edinder Eddamazain, Efasher, Egenaina and Kuboshia.Table (2) and (3).

Shape index:

On the other hand shape index showed significant difference between provenances where there is significant difference between parameters in Elgadaref, Eldinder and Eddamazain, all these provenances have high value (1.93) (1.91) (1.89) respectively. Some provenances showed high significant differences where high value was found in Kadogly (2.262) cm followed by Elgadaref (1.89) cm Eddamazain (1.85) cm Elgenaina (1.84) cm Eldindder (1.81) cm Elfasher. Table (2) and (3).

Size index:

Size index recorded highly significant difference, where high value was found in Kadogly (7.72%) followed by Elgadaerf (6.74%), Eddamazain (6.65%), Eldindder (5.98%), Elgenaina (5.84%), Elfasher (5.68%) and the lowest one found in Kuboshia (River Nile State). Table (2-3). This variation was obvious between provenances in morphological characters, this result in line with Abssae et al 2010 on fruit in Niger confirmed a great variability in Balanites aegyptiaca fruits, and similar to the work of Malaisse (2010) that said the biological and morphological composition of the fruits varies with the variety to distinguish among varieties. Table (2) and (3).

Conclusions:

The provenances studied covered most parts of Sudan. However they showed very highly significant differences between them in all morphometric characters studied. The study revealed two distinct groups of provenances. One group represent the areas of high rainfall and vertisol and clay soil of central Sudan. The other group represent areas of dominantly sandy soil and were of low rainfall. Generally the group belongs to high rainfall areas have significantly greater value of all morphometric characteristic. This give great opportunity of selection breeding and improvement in future programs of Balanites aegyptiaca in Sudan.

Table (2) Anova of Morphometeric characteristic of *Balanites ageyptica* in Seven Provenances

Source of variation	D.F	Seed characteristic														
Prov.	6	Seed weight			Seed length			Seed diameter			Seed shape			Seed size		
		SS	MS	F.value	SS	MS	F.value	SS	MS	F.value	SS	MS	F.value	SS	MS	F.value
		575.59	96.09	119.90***	14.31	2.38	10.69***	8.46	1.41	31.76***	7.60	1.27	45.24***	172.45	28.74	22.59***

*** Significant difference at (p ≥ 0.05) ** high significantly differences at (p ≥0.001) *** highly significantly differences at (p ≥0.0001)**

Table (3) Summary of Morphometric Variations characteristics of *Balanites ageyptica* in Seven Provenances of Sudan

Source of variation / Prov.	Seed Weight	Seed Length	Seed Diameter	Seed Shape	Seed Size
Elgadaref	8.44^{a}	3.614^{e}	1.89^{b}	1.93^{a}	6.74^{b}
Eddinder	7.89^{b}	3.33^{cb}	1.81^{cb}	1.91^{a}	5.98^{c}
Kadogly	6.49^{c}	3.42^{b}	2.265^{a}	1.51^{c}	7.72^{a}
Eddamazin	6.44^{d}	3.67^{a}	1.85^{cb}	1.98^{a}	6.65^{b}
Elfasher	6.44^{d}	3.14^{c}	1.81^{cb}	1.74^{b}	5.68^{c}
Elgenana	6.33^{d}	3.17^{c}	1.84^{cb}	1.73^{b}	5.84^{c}
Kuboshia	3.96^{e}	3.16^{c}	1.78^{cb}	1.79^{b}	5.60^{c}

Means with same letters in a same columns are not significantly different at (p ≥0.05) Using Duncan New Multiple Range Test (DNMRT)

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