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Seed Germination and Seedling Growth Performance of *Adansonia Digitata* L. Tree

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Abstract-The study was conducted on *Adansonia digitata* (L.) tree (Baobab tree) seeds that have hard coats and, germination usually less than 20%. Effect of seeds dormancy had been attributed to eco-physiological and biological seeds characters. The objective of the study was to carry out germination trials to launch a feasible package for seed germination and seedling growth performance in nursery. Seeds were collected from Al-Abassya Region South Kordofan State and the work was carried out at Soba Forest and gum Arabic Research Centre. Five treatments were applied to seeds associated with seasons of sowing; autumn, winter and summer. One seed lot per treatment, date and season was assigned randomly for following treatments; sulphuric acid of 96% and 50% concentrations were applied for 30 and 5 min., boiled water and control. After the germination count the germinated seeds were sown in polythene bags of size 30×20 cm, filled with 2/3 sand and 1/3clay soils in three replicates to establish seedlings stock in nursery. The results showed that concentrated H_2SO_4 soaked for 30 minutes had a high significant effect ($P > 0.001$) which gave (34%) seed germination compared with all other treatments during summer season. No significant differences were obtained by both treatments of H_2SO_4 and boiled water, but highest values were obtained with boiled water (44%) and concentrated H_2SO_4 for 5 min (41%) during autumn. Seedling growth parameters measured of different treatments, showed direct correlation with increasing ages of seedling. It is recommended that autumn season and treatments with H_2SO_4 conc.5m and boiled water for sowing seeds of *A. digitata,* and H_2SO_4 soaked for 30 minutes during summer season

Keywords: *Adansonia, digitata*, germination, seed, dormancy.

Introduction

Arid and semi-arid regions are blessed with many forest tree and shrubs species like Acacias , palm and others which provide shade, an aesthetic sight, or fruits, tannins resins, oils,
extracts, medicinal pharmaceutical products (Orwa, *et al*., 2009). *Adansonia digitata* L. tree belongs to Bombaceaceae family and it is a massive, deciduous tree up to 25m in height, has thick, angular, wide spreading branches, short stout trunk and attains 10 to14m or more in girth. The form of the trunk in young trees is conical, and in mature ones, it may be cylindrical, bottle shaped or tapering with branching near the base (El-Amin, 1990). In Sudan *A. digitata* tree is called *Tebaldi* and people make juice by soaking and dissolving the dry powder pulp in the fruit and make a refreshing drink, locally known as *Gonguleis*, which is rich in vitamin C and B2 (Sidibe and Williams, 2002).. Recently, the European Commission authorized the import of baobab fruit pulp as a novel food Buchmann, *et. al.*, 2010) and it was approved in 2009 by the Food and Drug Administration as food ingredient in United States of America (Addy, 2009). Nevertheless almost all parts of *A. digitata;* leaves; bark and fruits are traditionally employed as food stuffs that possess high nutritional values and for medicinal purposes, and hence baobab is named: the small pharmacy or chemist (Shashi, 2010).. There are normally 2000-3000 seeds/kg (Orwa, *et al*., 2009). and Baobab seeds have very hard seed coats and germination is usually less than 20 percent (Danthu, 1995). Seeds are probably orthodox; no loss in viability during 1 year of hermetic storage at 4ºC; and viability can be maintained for several years in hermetic storage at 3 ºC with 8-11% mc. However several methods were used to get rid of dormancy negative effects such as; wet heat, total or partial seed de-coating, and scarification of seeds with concentrated acids (Ali, and El-Tigani, 2015). Moreover herbicides, fungicides and growth regulators were tested and seeds treated with herbicides and fungicides did not germinate (Esenowo, 1991).

The seed germination of most trees under natural conditions is a limit factor for natural regeneration and establishment. However natural regeneration of Baobab trees is poor due to negative effects of browsing animals and uncontrolled bush fires. Also the depth of seed sowing and soil type affect seed germination and seedling performance of *A. digitata* in nursery. It was reported that germination term often used loosely and sometimes incorrectly, being confounded with seedling growth, which begins when germination finishes. Therefore the global germination process is constituted by three partial processes, the imbibitions, the activation and intra-seminal growth that is completed with embryo protrusion (Llabouriau, 1983a). It has been reported that effective mechanical treatment is to crack the seed coat, but this can damage the seed (Teel, 1984). However it was also observed that, the seed germination period varies from 3 weeks to 6 up to 12 months and was affected by quantitative aspects such as, age of seeds as well as treatment type and time (Bewlewy and Black 1994). For baobab fruit desirable traits were high and continuous production, large size with high proportion of pulp as well as good taste and high nutrient contents. Therefore seed size and shape vary depending on form of ovary and the condition under which seed embryo size matured, amount of endosperm stored and other tissues that are a part of seed structure (Ali and El-Tigani, 2015; Khalil and Siam, 2003; Ria and Khan, 2016).

However, according to the reviewed literature, seed germination is slow; take a long time and with low percentage and

growth. The need is to test factors affecting variation in germination of *A. digitata* seeds. Seedling production in nurseries for plantations could allow for conservation of genetic diversity through selection and mass production of trees with desirable selected characteristics of *A. digitata* tree. Overall there are needs to highlight and formulate information regards germination, growth, development, and management for investment, restocking, domestication and conservation of *A. digitata* tree.

Research objective:

The aim of this study is to develop protocols for propagation of *A. digitata* through seeding and determine the best package for plantation in nursery.

Materials and Methods

The experiment was conducted at the Forest and gum Arabic Research Centre at Soba**.** The Seeds were collected from Al-Abassya Region South Kordofan State. Seed treatment experiment included five treatments which were applied according to season of sowing, autumn, winter and summer; one seed lots per season and treatment date was assigned randomly for the treatments; T1- Sulphuric acid of 96% concentration Seeds were immersed in sulphuric acid with concentration 96% in beakers for 30 minutes then washed by tap water, T2--Sulphuric acid of 96% concentration Seeds were immersed in sulphuric acid with concentration 96% in beaker for 5 minutes then washed by clean water, T3-Sulphuric acid of 50% concentration Seeds were immersed in sulphuric acid with diluted to 50% by water in pottery dish for 30 minutes then washed by clean water, T4- Boiled water; seeds were immersed in water after boiled and take it until water cold then seeds washed, T5-Control; seeds were used without treatment.Treated seeds were planted in germination containers of length 30×30 cm, filled with 2/3 sand and 1/3clay soils and each one contained 100 seeds, The sets of experiment were laid under 70% shade of green net and germination counts were recorded after 48 hours for each treatment for 3 months. For seedling growth performance, ten seedlings were taken randomly from each treatment once weekly for measurements for 12 weeks. The growth parameters measured were; diameter, number of leaves, branching, survival percentage; main length of roots, and all were subjected to analysis of variance (ANOVA) and expressed at 95 per cent confidence level. All sets of the conducted experiments unless otherwise mentioned; were laid in the nursery of 70% shade and irrigated manually by can sprayer. The sets of experiment were arranged in a complete randomized design with three replicates. Analysis of variance (ANOVA) was carried out to test the significance between treatments and percentages of germination, mean values of seed and seedling parameters, followed by multiple comparisons using Duncan's Multiple Range.

Results and Discussion

The problems of delaying and poorness in seed germination were referred to dormancy caused by seed coat thickness and pulp. In addition to variations in seed characters due to the eco-physiological and biological effects exerted by its distribution in various ecological zones. Nevertheless dormancy also predisposes the seed to respond to specific environmental conditions that will favor seedling survival and maximize species proliferation. Therefore to solve above mentioned problems a series of various treatments were conducted to break dormancy and enhance germination of *A. digitata* seeds. Accordingly treatments with sulphuric acid (H_2SO_4) in different dilutions, tap and boiled water with time were used. Table (1) showed that concentrated H_2SO_4

soaked for 30 minutes had a high significant effect (P > 0.001) which gave 34 percent seed germination compared with all other treatments during summer season. Similar result was also obtained by CGLAR (2014) work on germination of *A. digitata* seeds.

Table 1 Effects of treatments on seed germination percentages of *Adansonia digitata* during summer season

No. of treatment	Treatments	Germination percentage
1	H_2SO_4 conc. 30m	34.33a
2	H_2SO_4 conc.5m	26.66b
3	H_2SO_4 dil. 30m	14.00c
4	Boiled water	19.00c
5	control	07.00d
SE		0.6853
Prob.		<0.001
C .V		16.22

Means with different letters in the same column were significantly different using Duncan Multiple Range Test.

The treatments with boiled water and concentrated H_2SO_4 for 5 minutes on percentages of seed germination (Table 2) showed a high significant effect (p > 0.011) which gave 44% and 41% respectively. On the other hand 50% diluted H_2SO_4 for 30 min, concentrated H_2SO_4 for 30 min. and the control gave lower seed germination percentages on autumn season. The results obtained were in agreement with El-Tigani, S (2015) work on *A. digitata* seeds treated with wet heat and concentrated acids gave high germination percentages than the control. The effects of water and hot alkali acid treatments probably increased enzymatic activity of amylase in seeds of *A. digitata*. Similarly Andrew (2004) works on *A. digitata* seeds obtained 44% using hot water, and hence concluded that seeds were best sown in autumn and summer. The treatments by concentrated H_2SO_4 for 30 minutes and boiled water in table (3) showed high significant effect (p=0.001) and gave 21and 22% germination respectively; comparable to low germination percentage in 50% diluted H_2SO_4 for 30 minutes and 90% concentrated H_2SO_4 for 5 minutes and the control during winter season. The results were similar to (Danthu, *et al*., 1995) work on seeds that have hard seed coats gave germination less than 20%. Similarly low germination percentage (20%) was reported by Sayda (1996) in the control that was referred to hard seed coats.

Table 2 Effects of treatments on seed germination percentages of *Adansonia digitata* during autumn season

No. of treatment	Treatments	Germination percentage
1	H_2SO_4 conc. 30m	29.66b
2	H_2SO_4 conc.5m	41.66a
3	H_2SO_4 dil. 30m	29.66b
4	Boiled water	44.00a
5	control	26.66b
	SE	0.7343
	Probability	<0.0112
	C .V	11.7

Means with different letters in the same column were significantly different using Duncan Multiple Range Test.

Table 3 Effects of treatments on seed germination percentages of *Adansonia digitata* during winter season

Treatment No	Treatments	Germination percentage
1	H_2SO_4 conc. 30m	21.0a
2	H_2SO_4 conc.5m	14.3b
3	H_2SO_4 dil. 30m	07. 7c
4	Boiled water	22.7a
5	control	01.7d
S E		0.4503
Probability		<0.001
C .V		11.81

Means with different letters in the same column were significantly different using Duncan Multiple Range Test.

Table No 4 Comparative effects of treatments on seed germination percentages of *Adansonia digitata* during all seasons

Treatments	Summer season	Autumn season	Winter season	**CV%**
H_2SO_4 conc. 30m	34. 3a	29.7b	21.0c	12.37
H_2SO_4 conc.5m	26.7b	41.7a	14.3c	17.70
H_2SO_4 dil. 30m	14.0b	29.7a	07. 7c	16.71
Boiled water	19.0b	44.0a	22.7b	18.53
Control	07.0b	26.7a	01.7c	16.77
S. E	0.6853	0.7343	0.4503	
Probability	<0.001	<0.011	<0.001	
C .V	16.22	11.70	11.81	

Means with different letters in the same column were significantly different using Duncan Multiple Range Test.

The effects of the selected treatments on seed germination during each of the three seasons were shown in table (4), where high significant effects were obtained between the seasons. The autumn season had high significant difference in seed germination percentages compared to summer and winter seasons. No significant differences were obtained by both treatments of H_2SO_4 and boiled water, but highest values were obtained with boiled water (44%) and concentrated H_2SO_4 for 5 min (41%) during autumn. The low seeds germination percentages were manifested in winter and significant differences were obtained in the control for all seasons (26, 7, and 2%). These results obtained were in agreement with Palmer and Pitman (1972) works where they found that there was no or little germination performed in the control by *A. digitata* dry seed in nursery.

The study suggests that *A. digitata* seed seems to be more physiologically efficient to utilize the substrate in environment with some stability in high temperature regime. It

is presumed that seed which are produced in summer might have different protein nature and have adaptability against extreme environmental conditions. Therefore it could be concluded that physiological attributes probably reflect the variation in the enzyme amylase proteins seasonally produced by *A. digitata* seed. Based on the manifested results it is recommended that autumn season and treatments with H_2SO_4 conc.5m and boiled water for sowing seeds of *A. digitata.*

The effects of different treatments on growth parameters were shown in figure (1); that showed direct correlation when the age of seedling increasing with treatments. Most tree species probably showed great variation in adaptability, growth performance that occurred between provenances, families, sites within provenances, stands within tree sites, individual trees and within trees (Ahmed, 2005)

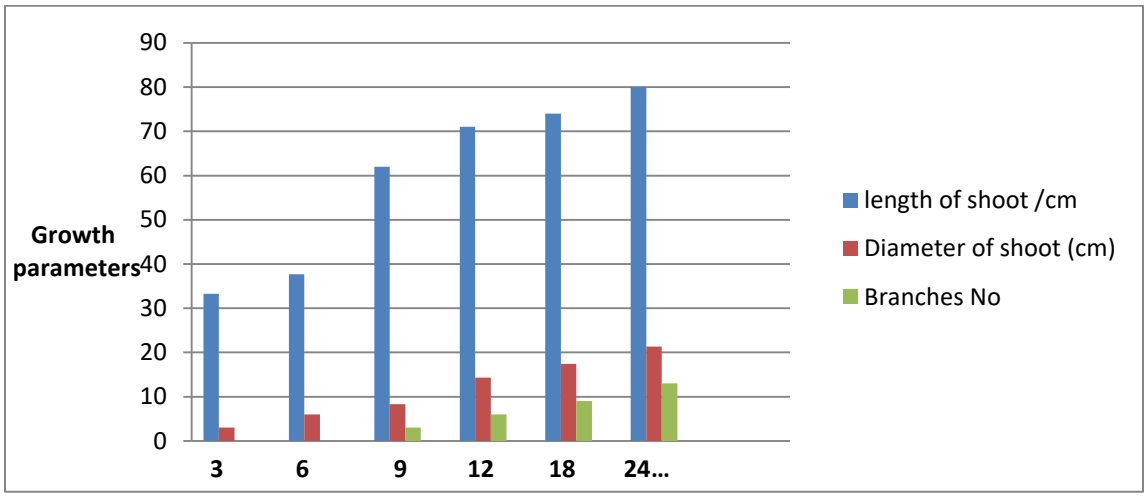

Fig. 1 Mean growth performance if Adansonia digitata developmental stages

Conclusion

Due to the increased interest in baobab products and slow growth, development of protocol for propagation by seeding and seedling establishing in nursery is essential if *A. digitata* is to be promoted for wider cultivation and use. Selection of superior seed of *A. digitata* known mother trees with desired traits could help supply domestic and international markets with high fruit quantities. Domestication and cultivation of *A. digitata* probably will aid in conservation in natural habitats and; contribute to improve nutritive value and income of local communities in South Kordofan region, Research should be directed on how to develop a cultivar with a short maturation period. Variations in chemical composition of fruit pulp highlighting need to set quality standards for seed oil as they are important commercial commodities.

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الإكثار بالبذور وأداء النمو المظهرى لشجرة التبلدي

زهراء موسى بدوى خليل و يحيى حامد على البشير
مركز الابحاث سوبا

المستخلص

أجريت الدراسة على بذور شجرة التبلدى ذات الغلاف الخارجى الصلب و وجد أن نسبة الإنبات لا تتجاوز 20%. تأثير الكمون البذرى أرجع إلى خصائص البذور البيئية الفسيولوجية و الإحيائية. و الهدف من الدراسة إجراء تجارب الإنبات لإيجاد حزمة سهلة لإنبات البذور و أداء النمو المظهرى بالمشتل. جمعت بذور شجرة التبلدى من منطقة العباسية بجنوب ولاية كردفان و أجريت التجارب بمركز أبحاث الغابات و الصوغ العربى بسوبا. و تم تطبيق خمس معاملات للبذور مرتبطة بمواسم البذر و هى الخريف و الشتاء و الصيف. أستخدم حامض الكبريتيك المركز لفترات زمنية 30 و 5 دقائق والمخفف لمدة 30 دقيقة و كذلك أستخدم الماء المغلي للبذور. و بعد الإنتهاء من أخذ قراءآت تجربة الإنبات و ضعت الشتول النامية فى أكياس البلاستيك ذات حجم 30× 20 سم تحوى تربة الزراعة بنسبة 1/3 قريرة و 2/3 رمل لمتابعة أداء النمو المظهرى. و أظهرت النتائج أثر معاملات حامض الكبريتيك المركز (96%) والمخفف (50%) والماء المغلي علي إنبات البذور بالمشتل فى المواسم الثلاثة. و أظهرت النتائج أن نسبة إنبات البذور عند إستخدام الماء المغلي في موسم الخريف كانت ألافضل مقارنة بالمعاملات الأخري. و كما أعطي حامض الكبريتك المركز لمدة 30 دقيقه أعلي فرق معنوى في نسبة إنبات البذور في موسم الصيف (34%) مقارنة بالمعاملات الأخرى. لا توجد إختلافات معنوية بمعاملتى الحامض و الماء المغلى و لكن القيم العالية أوجدت بغستخدام الماء المغلى (44%) و الحامض لمدة 5 دقائق أعطى (41%) أثناء الخريف. الأداء المطهى للنمو أظهر إرتباط مباشرمع زيادة عمر الشتول. توضى الدراسة بأن موسم الخريف و المعاملة بحامض الكبريتيك المركز لمدة 5 دقائق و الماء المغلى أفضل لزراعة البذور بينما حامض لمدة 30 دقيقة الأفضل لزراعة البذور قى فصل الصيف.