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Studies on the Dormancy and Germination of Stony Fruits of Hog plum (*Spondias mombin*) in Response to Different Pre-Soaking Seed Treatments

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Abstract

Different parts of Spondias mombin plant is known for its diverse ethnopharmacological uses in different parts of the world. However, the seeds are dormant and the tree species remain undomesticated. The dormancy and germination of stony fruits of Hog plum (Spondias mombin) in responses to different pre-soaking seed treatments was carried out in the forest nursery unit of the Department of Forestry and Wildlife Management of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. Seeds were subjected to three main pre-soaking treatment methods each at three different duration of exposure; soaking in hot water, exposure to oven drying heat and soaking in 60% concentrated acid solutions (H_2SO_4, HNO_3 and HCl) while the controls were sown without treatment. The results showed that 60% concentrated H_2SO_4 for 25minutes produced the highest (75%) germination. Soaking in hot water at 100°C for 3minutes and exposure to oven drying heat at 90°C and 100°C for 3minutes gave poor germination (1%). It was however recorded that all the controls showed poorest germination (0%) under the same experimental conditions. Germination was observed to be enhanced by increase in the period of soaking from 15min. to 25mins in 60% concentrated acids solutions (H_2SO_4, HNO_3 and HCl) except with HCl at 25mins. The increased seed germination through pre-soaking for 25mins in 60% conc. H_2SO_4 nicking suggest that seed dormancy in S. mombin is mainly due to the chemical inhibitors and hard seed covering which renders the tough and corky endocarp impermeable to water and gases required for germination process. The information gathered in this research work will assist in solving the problems of seed dormancy for easy propagation of this highly demanded tree species.

Keywords: Hog plum, seed dormancy, seed germination, chemical inhibitors, acid scarification.

Introduction

Germination is the growth of an embryonic plant contained within the seed which result in the formation of the seedling. The seed of higher plant is a small packaged produced in a fruit or cone after a union of the male and female sex cell. All fully developed seeds contain an embryo and in most plant species some food reserves are stored in the seed coat[1]. Germination also, incorporates those events that commence with the uptake of water by the quiescent dry seed and terminate with the elongation of the embryonic axis[1]. The visible sign that germination is complete is usually the penetration of the structure surrounding the embryo by the radicle, the result is often called visible germination. Subsequent events, including the mobilization of the major storage reserves are associated with growth of the seedlings virtually all of the cellular and metabolic events that are known to occur before the completion of germination of non-dormant seeds may also occur in imbibed dormant seeds. Seed dormancy is regarded as the failure of an intact viable seed to complete germination under favourable conditions. This could also be known to be as a seed characteristics or the degree of which defines what conditions should be met to make the seed germinate. There are many types of seed dormancy. These include: dormancy imposed by hardness of seed coats or impermeability of tegument; dormancy induced by presence of inhibitors; conditions of light; and dormancy due to embryonic immaturity[2]. The first and the last dormancy types were found in the seeds of *S.mombin.* Hog plum is native to the Caribbean and tropical America from where it has been dispersed under Spanish influence. The plant has anthropogenic tendencies and hence it is often naturalized around villages in West Africa. This plant is common in South West of Nigeria. *S. mombin* commonly called Hog plum is of the plant family Anacardiaceae. In Nigeria, the fruit is called 'iyeye' while the tree is called 'akika' by Yoruba; Edo called the fruit 'oheeghe' while the tree were called 'nsukakara' by Efik, 'tsadar masar' by Hausa, 'ijikara', 'ogogo', 'ngwu' or 'ungwu' by Igbo, 'aginiran' by Ijaw and 'kakka' by Tiv[3]. *Spondias mombin* measures up to 20metres tall. It grows in the rainforest and in the coastal area. The fruit is like the temperate plum, 3.7 centimetres long, ovoid, one-seeded, yellow-skinned when ripe. Several basic methods are used to overcome seed coat dormancy in many species. The mechanism for breaking dormancy varies from species to species and most often involves drying, exposure to high or low temperature, exposure to light, leaching of chemical inhibitors through soaking in cold or warm water, mechanical scarification such as nicking and chipping and acid scarification among other methods[4]. Research

findings indicated that *S. mombin* plant was a potential source of highly nutritious feed stuff and phytomedicine[5-7]. Therefore, they were of nutritional, clinical and veterinary relevance, considering the diverse ethnopharmacological uses of the plant in different parts of the world. As a result of this, it is of great importance to develop improved techniques for breaking seed dormancy in germination of *S.mombin* in other to enhanced mass production of uniform and vigorously growing seedlings of the plant in Nigeria. Though few studies have been conducted on different aspects of seed germination of *S.mombin*[8], currently no information is available on the effects of temperature regime and acid scarification on seed germination of *Spondias mombin.* The study was therefore designed to report the effects of temperature regime and acid scarification on seed germination of *Spondias mombin.*

Material and Methods

Fruit collection, processing and viability test: Matured and ripe fruits of *Spondias mombin* (figure 1) were collected randomly from fruiting branches of a healthy plant in their natural habitat, besides the proposed secretariat site of Senior Staff Association of Nigerian Universities (SSANU) at the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria (7°N 3°E). Fruit stones seeds of *S. mombin* were extracted from the pulpy drupes, depulped by mashing with both hands in glove. The extracted seeds were hand picked into another container with the pulpy mess discarded. Viability test was carried out on the extracted fruit stones using the method of ISTA[4] and extracted viable seeds were used immediately for subsequent experiment.

Figure-1
Ripe fruits of *Spondias mombin* plant before extraction of seed

Experimental design and presoaking treatments: The experiment on germination studies of *S. mombin* seed pretreated was conducted at the forest nursery unit along the main gate of the Federal University of Agriculture, Abeokuta, Ogun State, Nigeria (7°N 3°E). At each sowing, there were twenty-seven (27) sub-treatments from three main treatments with each treatment at three different levels of time of exposure to treatment method: soaking in hot water, exposure to oven drying heat and soaking in acid solutions. The control experiment was the untreated seeds. Each sub-treatment had four replicates with a total of 100 seeds for each sub-treatment and 25 seeds per replicate. The experiments were laid out in a randomized complete block design.

Hot water treatment: Water was boiled and viable seeds were soaked in the hot water of 80°C, 90°C and 100°C for 1, 2 and 3 minutes, removed and allowed to cool. The seeds under this condition were prepared for germination. Untreated seeds served as control.

Oven Drying Heat Treatment: Viable seeds were also subjected to different temperature regimes of 80°C, 90°C and 100°C for 1, 2, and 3minutes in an oven. The oven used was already preset to the temperature value before the seeds were placed inside it. The seeds were allowed to cool and planted for germination. Untreated seeds served as control.

Acid Scarification: Viable seeds were soaked in 60% conc. Tetraoxosulphate (VI) acid, Hydrochloric acid and Trioxonitrate (V) acid for the periods of 15, 20 and 25minutes. The seeds were rinsed in running tap water several times before planting for germination test. Untreated seeds served as control.

Germination studies: The treated viable seeds and controls were planted in the perforated black polythene bag of 37cm by 31cm filled with loamy soil. Watering was done accordingly after sowing at the nursery, to keep the soil in the polythene bags moist. Germination was monitored on a daily basis up to 22 days after sowing (DAS) when no more germination was observed and seeds were considered germinated through successful emergence. Results were expressed as germination percentage which was the percentage of seeds that had germinated at the end of the experiment.

Data analysis: Results of the germination studies were subjected to an analysis of variance (ANOVA). Prior to statistical analysis, daily germination and cumulative percentages data were transformed into arc sine values to bring data to normality. For the significant treatments revealed by Analysis of Variance (ANOVA), means were separated by Duncan Multiple Range Test (DMRT).

Results and Discussion

Exposure of seeds to hot water for 1min at 80°C gave 35% germination (table 1). At 80°C, 90°C and 100°C, it was observed that there was decrease in percentage germination as the period of exposure increased from 1 min to 3 mins (table 1). Also increase in the temperature of the hot water treatment

resulted in decrease in the germination percentage (figure 2). Seeds subjected to hot water treatment at 100°C for 3 minutes showed 1% germination as compared to 80°C and 90°C for 3mins that gave 5% germination, respectively. Hot water treatment terminated seed dormancy of *Spondias mombin* better at 1min period of soaking at 80°C in comparison to others (figure 2).

Effects of Oven Drying Heat Treatment on *S. mombin* Seeds: The result showed that the exposure of seeds to oven dry heat treatments for 1min at 80°C gave highest percentage germination of 25 (figure 3). Also, the germination percentage also decreased as the temperature and the period of seed exposure increased (figure 3). The oven drying heat treatment at 80°C for 1min broke the seed dormancy best when compared to 2mins and 3mins (table 2)

Effects of Acids Scarification on *S. mombin* seeds: Acid scarification result showed that seeds scarified in 60% concentrated H_2SO_4 for 25 minutes gave 75% germination when compared to those soaked in 60% concentrated HNO_3 and HCl which were much lower (figure 4). There was increase in the germination percentage with the time of treatment except for the seeds treated for 25minutes in 60% concentrated HCl that recorded the same germination percentage of 30 with 60% concentrated HCl for 20 minutes (table 3). There were significant differences between the acid scarification treatments and control at < 0.05 (table 3).

Table-1
Effect of hot water treatments on seed germination of *S. mombin* at 22 days after sowing

	Hot water treatment			
Period of soaking	**80°C**	**90°C**	**100°C**	**Control**
1min.	35^a	20^a	15^c	0^d
2mins.	15^a	10^b	10^b	0^c
3mins.	5^a	5^a	1^b	0^c

Mean in the same row followed by the different letters are significantly different according to DMRT at P < 0.05.

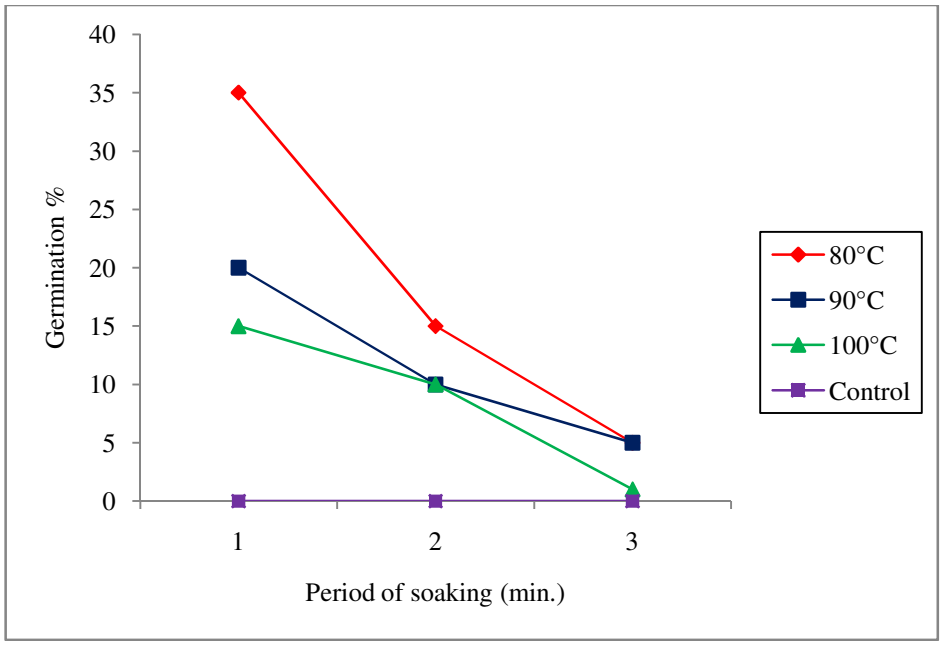

Figure-2
Percentage germination of *Spondias mombin* seeds subjected to hot water treatment

Table-2
Effect of oven drying heat treatments on seed germination of *S. mombin* at 22 days after sowing

	Oven drying heat treatment			
Period of soaking	**80°C**	**90°C**	**100°C**	**Control**
1min.	25^a	20^b	15^c	0^d
2mins.	20^a	8^b	2^c	0^c
3mins.	5^a	1^b	1^b	0^c

Mean in the same row followed by the different letters are significantly different according to DMRT at P < 0.05.

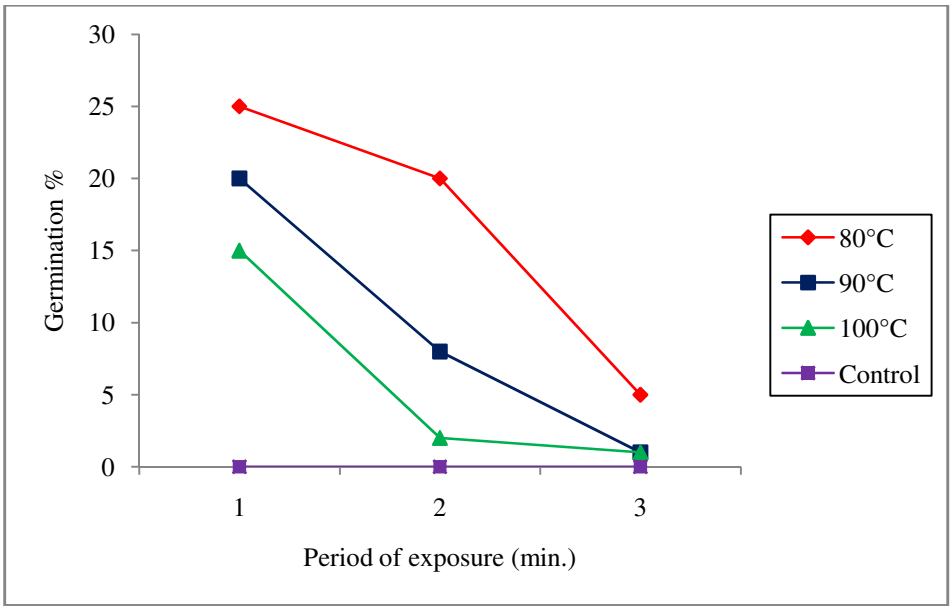

Figure-3
Percentage germination of *Spondias mombin* seeds subjected to oven drying heat treatment

Table-3
Effect of acid pre soaking treatments on seed germination of *S. mombin* at 22 days after sowing

	Pre-soaking treatment methods			
Period of soaking	**60% H_2SO_4**	**60% HNO_3**	**60% HCl**	**Control**
15min.	50^a	30^b	20^c	0^d
20mins.	55^a	35^b	30^c	0^d
25mins.	60^a	40^b	30^c	0^d

Mean in the same row followed by the different letters are significantly different according to DMRT at $P < 0.05$.

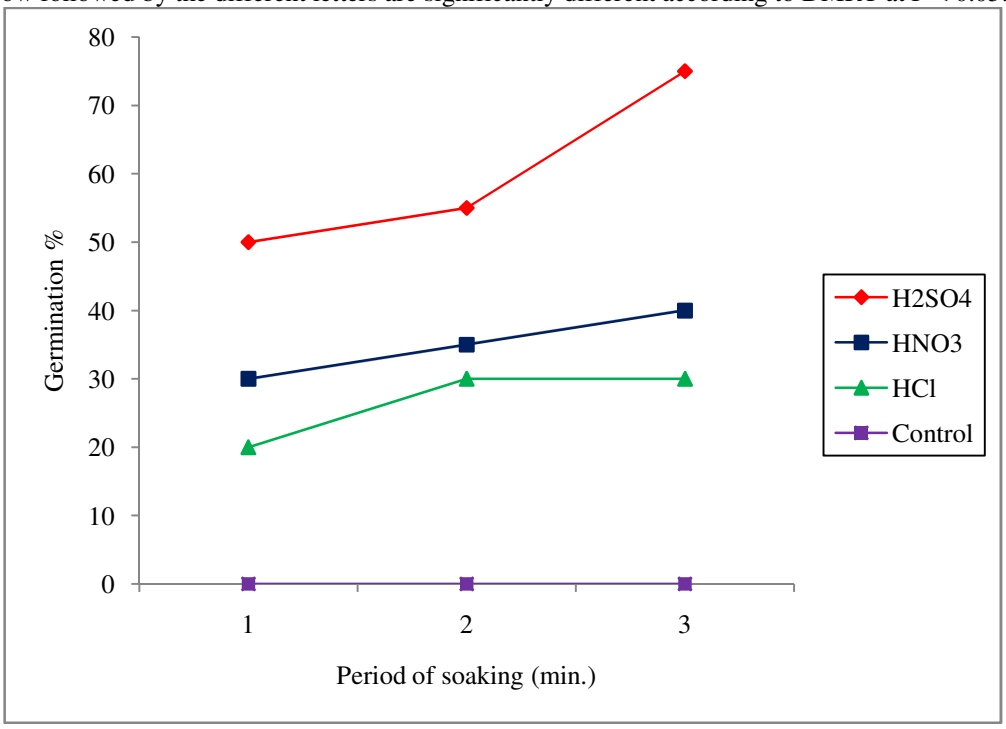

Figure-4
Percentage germination of *Spondias mombin* seeds subjected to acid pre-soaking treatments

Discussion: Practical methods of germinating seeds are important to foresters, nursery operators and others that are engaged in re-vegetation work, medicinal and economic uses of forest trees. Results showed that the seeds used in this study were viable but found to have dormancy. The seeds of *Spondias mombin* are enclosed in a tough and corky endocarp which constitutes the planting materials[8]. Many studies on the inhibitory effects of pulp of fleshy fruits on germination of seeds also indicated that inhibitors might be involved in the control of seed dormancy[9,10,11]. Results of this study clearly indicated that exposure of seeds of *S. mombin* to 60% concentrated H_2SO_4 for 25mins germinated better (75%) in comparison to all others methods for breaking dormancy in this experiment. 60% conc. H_2SO_4 was likely to have reduced the tough and corky endocarp of the *S. mombin* seeds with increase in treatment time, therefore breaking the dormant seeds of *S. mombin* for germination. As soon as the barrier was removed, water and gas gain entry into the seed to resume germination[12]. This result agreed with the termination of dormancy in seeds of *T.indica, P.biglobosa, A.lebbeck* and *P.africana using* concentrated sulphuric acid as a presowing agent[13]. McDonald and Omoruyi[14] reported higher seed germination of species with hard impermeable seed coat when treated with HCl. Fasidi *et al.* [15] observed that treatment with concentrated H_2SO_4 significantly increased germination ($P<0.01$) and that percentage germination increased with increase in treatment time until 25mins after which it decreased. Biswas *et al*.[16] also terminated dormancy in seeds of *Richardia scabra* using concentrated H_2SO_4 while Okonkwo and Nwoke[17] terminated dormancy in seeds of the parasitic African weed, *Alectra vogelii* using solution of sodium hypochlorite and calcium hypochlorite. Most scarification germination studies used acids such as H_2SO_4, HNO_3 and HCl in order to obtain good results[18,19,20]. Germination percentage of seeds decrease as the temperature and period of exposure increased (figure 2 and 3). Boiling of seeds in water at 80°C for 1min gave 35% germination while oven drying heating at 80°C for 1min gave 25% germination (figure 2 and 3). This may be an indication that the embryo of the seed suffered severe damage due to long period of boiling in water and heat drying exposure in oven. These results are similar to those reported by Otegbeye and Momodu[21], Ibrahim and Otegbeye[22] on *Parkia biglobosa* and *Adasonia digitata* germination trial respectively. The result obtained by Agboola[12] while working on the breaking of dormancy in seeds of *Prosopis africana* also confirmed this trend. In addition, Esenowo[23] observed similar results in his germination trials for *Adasonia digitata* by soaking the seeds in water with temperature of 60°C – 70°C for 40mins. All the untreated seeds (controls) in this experiment did not germinated but were viable.

Conclusion

However, method of breaking dormancy in the fruits of *S. mombin* points to the fact that the dormancy type in the seed consists of the innate physiological type caused by chemical inhibitors and mechanical dormancy due to hard seed coat. It could be inferred from this study that 75% germination could be obtained by soaking seeds of *S. mombin* in 60% concentrated H_2SO_4 for 25 minutes, thus helping to raise uniform and fast growing seedlings of *S. mombin* from its dormant seeds. Free distribution of this seedling to the rural dwellers for establishment and continuous afforestation should be encouraged by the concerned government agencies to meet its demand for ethnopharmacological uses in different parts of the world.

References

1. Bewley J.D. and Black M., *Seeds: Physiology of Development and Germination,* Plenum Press: New York, NY. 1-200 **(1994)**

2. Eira M.T.S. and Caldas L.S., Seed Dormancy and Germination as Concurrent Processes, *Brazilian Journal of Plant Physiology,* **12,** 85-103 **(2000)**

3. Fadimu O.Y., Ajiboye A.A., Agboola D.A., Kadiri M. and Adedire M.O., Effects of some combination of phytohormones on some growth parameters and vitamin, carbohydrate, protein and chlorophyll contents of *Spondias mombin* (Linn.) seedlings, *Ife Journal of Science,* **14(2)**, 397-403 **(2012)**

4. International Seed Testing Association (ISTA)., International Rules for Seed Testing. ISTA, Bassersdorf, Ch- Switzerland **(2003)**

5. Njoku P.C. and Akumefula M.I., Phytochemical and Nutrient Evaluation of *Spondias Mombin* Leaves, *Pakistan Journal of Nutrition,* **6(6),** 613-615 **(2007)**

6. Ayoka A.O., Akomolafe R.O., Akinsomisoye O.S. and Ukponmwan O.E., Medicinal and Economic Value of *Spondias mombin African Journal of Biomed Research,* **11,** 129–136 **(2008)**

7. Igwe C.U., Onyeze G.O.C., Onwuliri V.A., Osuagwu C.G. and Ojiako A.O., Evaluation of the chemical composition of the leaf of *Spondias mombin* Linn. from Nigeria, *Australian Journal of Basic Science*, **4(5),** 706 – 710 **(2010)**

8. Agboola D.A., The effect of fruit fermentation and some pretreatments on the germination of seeds of *Spondias mombin* (Linn.) *Asset series B,* **1(1)** 47-52 **(2002)**

9. Fasidi I.O., Fawole M.O., Olafinboba M.O. and Akinyanju J.A., Germination inhibitors in the fruits and seeds of *Chlorophora excels, Nigerian Journal of Science,* **13,** 389–391 **(1979)**

10. Ibrahim A.T. and Nwoboshi L.C., Effects of presowing treatments on germination of Teak and *Gmelina* seeds, *Nigerian Journal of Forestry,* **16(1&2),** 20-24 **(1986)**

11. Okoro O.O., Revolutionising processing of *Gmelina arborea* seeds in Nigeria, Proceedings of Forestry Association of Nigeria, 13th annual conference Benin, Nigeria **(1993)**

12. Agboola D.A., Studies on dormancy and germination of seeds of *Prosopis africana (Guil & Perr) Taub. Nigerian Journal of Botany,* **8,** 45-56 **(1995)**

13. Ajiboye A.A. and Agboola D.A., Some aspect of dormancy studies and vitamin D content in four tree seed species, *International Research Journal of Plant Science,* **2(2),** 32-36 **(2011)**

14. McDonald I. and Omoruyi O., Effect of seed pre-treatment on germination of two surface types of *Dialium guianeense Seed Technology,* **25,** 41-44 **(2003)**

15. Fasidi I.O., Tsamani T., Kadiri M. and Agboola D.A., Studies on growth inhibitors and promoters in dormant and germinating seeds of *Parkia biglobosa, Nigerian Journal of Botany,* **13,** 89-95 **(2000)**

16. Biswas P., Bell K. and Crayton P., Germination behaviour of Florida Puley seeds, *Weed Science,* **23(5),** 400-403 **(1975)**

17. Okonkwo S.N.C. and Nwoke F.I.C., Bleach-induced germination and breakage of dormancy of seeds of *Alectra vogelli. Physiolog Plant,* **35(5),** 175-180 **(1975)**

18. Marunda C.T., Effect of seed pretreatments on the development of *Acacia auriculiformis* and *A. holosericea* seedlings, In ACIAR Proceedings, *Tropical Tree Seed Research*, **28,** 33–36 **(1990)**

19. Gunn B.V., Germination pre-treatment for selected Acacia species from the Pilbara region of Western Austrialia, In ACIAR Proceedings, *Tropical Tree Seed Research,* **28,** 46–50 **(1990)**

20. Lemma G. and Scarisbrick O., Germination of *Chamaecytisus palmensis* as affected by ageing and method of pre-germination treatment, *African Crop Science Journal,* **(2),** 165–171 **(1999)**

21. Otegbeye G.O. and Momodu A.B., Preliminary study of germination techniques for seeds of *Parkia biglobosa Journal of Agric. and Environ.,* **4(1),** 32–41 **(2003)**

22. Ibrahim A. and Otegbeye G.O., Methods of achieving optimum germination in *Adasonia digitata, Bowen Journal of Agriculture,* **1(1),** 53–59 **(2004)**

23. Esenowo G.T., Studies of germination of *Adasonia digitata* seeds, *Journal of Agricultural Science,* **117,** 81–84 **(1991)**