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STORABILITY AND PRE-SOWING TREATMENTS OF AFRICAN STAR APPLE (*CHRYSOPHYLLUM ALBIDUM* G. Don) SEEDS

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ABSTRACT

Chrysophyllum albidum is a prominent, indigenous, economic fruit tree species found in compound farm agro-forestry systems . Investigation was conducted to overcome difficulty in germination and storability of *C. albidum* seeds in the forest nursery of Federal University of Agriculture, Abeokuta, Nigeria. The trial employed a 3x3 factorial experiment with three replications laid out in a completely randomized design to determine the effect of seed coat treatments including clipping at 2mm from distal, circumference and micropyle end; dipping in 10% sulphuric acid and no seed coat treatments and durations of seed storage 1, 5 and 9 days on the germination of *C. albidum* seeds. Pre-sowing and storage treatments significantly ($p < 0.05$) affected the germination of seeds. Percentage germination ranged from 17% to 61% for clipping to no seed coat treatment. Highest germination of 61% was recorded for seeds not pre-sowed. The percentage germination ranged from 16% to 60% for seeds stored for nine days to those stored for one day. Highest germination of 60% was recorded for seeds stored for one day. A significant ($p < 0.05$) decrease in percentage germination was recorded with increasing days of storage. The result of interaction effect revealed that highest germination of 86% was recorded for seeds stored for 5days without pre-sowing treatments. Storing of seeds for 5days is recommended for mass production of *C. albidum* seedlings in agro-forestry nursery.

Key words: Clipping, Dipping, length of storage, Sulphuric acid, Indigenous trees species

INTRODUCTION

African star apple or White star apple is a climax tree species of tropical rainforest that belongs to the family Sapotaceae (Wole, 2013., Olaoluwa *et al.,* 2012) which has up to 800 species and make up almost half of the order (Ehiagbonare *et al.,* 2008). The Yoruba name is "Osan Agbalumo" (Rahaman, 2012) while in Igbo and Hausa languages, it is called "Udara" or "Udala" (Wole, 2013) and Agbaluba or Agbaluma respectively. It exists without regeneration, principally as a volunteer or deliberately protected plant in its natural habitats, villages, backyard gardens and so on from where fruits are collected for direct consumption and marketing . This 'wild fruit' tree species of West and Central Africa (Rahaman, 2012) is equally reported in diverse eco-zones of Cameroon and Cote d'Ivoire (Bada, 1997 and Wole, 2013).

It is cherished by all and sundry, eaten fresh and popular with mature and older people

(Olaoluwa *et al.,* 2012 and Rahaman, 2012) and capable of producing from 14,000 – 15,000 per tree fruits annually (Dike *et al.,* 1997). It is among the forest tree species which is integrated in the traditional agroforestry system (Ureigho and Ekeke, 2010; Laurent *et al.,* 2012) that provide Non Timber Forest Products (NTFPs) of immense domestic importance to rural and urban dwellers in West Africa, with great export potentials (Nwoboshi, 2000). *C. albidum* has been noted to be of great economical (Adebisi, 1997, Oboh *et al.,* 2009, Onyekwelu *et al.,* 2011 and Olaoluwa *et al.,* 2012)., nutritional, medicinal (Adisa, 2000 and Onyekwelu and Stimm, 2011) and industrial (Amusa *et al.,* 2003, Olaoluwa *et al.,* 2012, Rahaman, 2012) as well as ecological values (Aduradola *et al*., 2005).

The centre of widest diversity of *Chrysophyllum* germplasm in Nigeria (Onyekwelu *et al.,* 2011) is the Southern rainforest zone with considerable variations in plant morphology, yield and other agronomic characters (Denton, 1997). This area, which is about 129.500km^2, represents about 14% of the total land area of Nigeria (Denton, 1997). Ladipo *et al*. (1997) reported that the diversity in *C. albidum* types, adaptability to local environment and resistance to biotic stresses make them potentially useful for crop improvement. Extensive human activities deplete the population of unregenerate *C. albidum* (Onyekwelu *et al.,* 2011) during irreversible conversion of forest areas to other uses.

In spite of enormous benefits of *C. albidum*, it has been greatly neglected particularly with respect to its regeneration. There is dearth of quantified information on the germination and storability requirement of the *C. albidum* seeds for biodiversity conservation. The *C. albidum* seeds have hard seed coat which is impermeable to water to hasten germination. This characteristic is a major reason for seed dormancy leading to uneven germination which is a major setback in reforestation programmes (Aduradola *et al*., 2005). In view of this, pre-sowing and storage trials were conducted to assess the germination and storability of *C. albidum* seeds for mass production of its seedlings for agroforestry conservation programmes.

MATERIALS AND METHODS

Study Site

The experimental site was the forestry nursery of the Federal University of Agriculture, Abeokuta, Nigeria. The nursery is located within latitude 7^{o}N and 7^{o}N 55^1 and longitude 3^o 20^{1}E and 3^{o}37^{1}E of the Federal University of Agriculture, Abeokuta. The Federal University of Agriculture, Abeokuta is located within the rain forest zone of South Western Nigeria (Amujoyegbe *et al.,* 2008). It is next to Ogun-Osun River Basin Development Authority (OORBDA), along Osiele-Abeokuta road, off Abeokuta-Ibadan road. It is in the North Eastern end of Abeokuta and lies approximately on latitude 7^{o}30' N and longitude 3^{o}54' E. It lies within the humid lowland rain forest region with two distinctive seasons. The wet season extends from March to October while the dry season extends from November to February (Aiboni, 2001). The rainfall has a characteristic bimodal distribution with peaks in July and September and breaks in August. Generally, the rainfall could be heavy and erosive sometimes accompanied by lightning and thunderstorm at the beginning and the end of rainy season. The mean monthly temperature varies from 22.9^{o}C in August to 36.32^{o}C in March. The relative humidity is high ranging from 75.52^{o}C in February to 88.15^{o}C in July (Aiboni, 2001). The vegetation of the

area comprises of low land forest become secondary rainforests or forest re-growth because of the increase in land use and exposure. The vegetation has the characteristics of tropical rain forest such as high forest and growth of massive trees and twinning shrubs. The forest is covered with litters of fallen trees by both human and natural activities (Ufoegbune and Fabiyi, 2016).

Seed procurement

Sweet variety of average sized 5cm diameter fruits of *C. albidum* were sourced from one mother-tree at Osiele town in Ogun State and transported to the nursery. Freshly extracted 810 randomly seeds were sterilized with 70% ethanol (C_2H_5OH) and 60% sodium hypochlorite for 10 seconds and rinsed with distilled water. The randomly picked samples of the seeds were cut open with chisel to assess the viability through the cutting method (Schmidt, 2000).

Dipping seeds in 10% concentrated H_2SO_4 (VI) acid

Sulphuric acid treatment was carried out to assess the effect of sulphuric acid on germination percentage of *C. albidum* seeds. A factorial experiment with 3 replications laid out in a completely randomized design was used. Thirty seeds represented a replicate. Ninety (90) seeds dipped in 10% concentrated H_2SO_4 (VI) acid for 10 seconds and sown on days 1, 5 and 9 after treatment respectively. Three replicates of seeds on each day were sown in 4cm depth (Adelani, 2015) of potting mixture of 200°C sterilized river sand and 3 days sun dried saw dust. The total weight of potting mixture was 6kg. Seeds watered to pot capacity in 27cm by 22cm poly bag size at 70ml/seed daily. Seeds were kept at 27°C average room temperature before sowing for experimental periods. *C. albidum* seeds started germinating 30days after sowing. Seed germination was monitored for 60 days after sowing.

Mechanical seed scarification

Mechanical seed scarification of *C. albidum* was carried out using the method of uniform seed coat clipping which involved clipping seeds at 2mm from the micropyle, around seed circumference and 2mm from distal end. A factorial experiment with 3 replicates laid out in a completely randomized design was used. Thirty seeds represented a replicate. Ninety (90) seeds clipped at 2mm from distal end, around seed circumference and 2mm from micropyle end and sown in a potting mixture of sawdust sundried for three days and river sand sterilized at 200°C on days 1, 5 and 9 respectively. Ninety (90) seeds on each day sown in 4cm depth (Adelani, 2015) of potting mixture of 200°C sterilized river sand and 3days sundried sawdust. Seeds watered to pot capacity in 27cm by 22cm poly bag size at 70ml/seed daily. Seeds were kept at 27°C average room temperature before sowing for experimental periods

Data analysis

Data were collected on the effects of duration of seed storage and seed coat treatments on the germination of *C. albidum* seeds. The data were subjected to analysis of variance (ANOVA) using "Fischer's Least Significant Difference (LSD)" at 5% level of significance. Germination count was recorded after the emergence of the plumule. Germination count was converted to germination percentage, which was obtained as the number of seeds germinated divided by the total number of seeds planted and multiplied by 100.

$$\text{Germination Percentage} = \frac{\text{Total seed germinated}}{\text{Total seed sown}} \times 100$$

RESULTS AND DISCUSSION

Effects of seed coat treatments and durations of seed storage on the germination of *C.albidum* seeds.

The effects of the seed coat treatments and durations of seed storage on the germination of *C. albidum* seeds are presented in (Table 1). A significant decrease in percentage germination was recorded with the various pre-sowing treatments. Percentage germination ranged from 17% to 61% for clipping to no seed coat treatment. The highest germination percentage of 61% was obtained in untreated seeds. A significant decrease in percentage germination was recorded with the increasing days of storage. The percentage germination ranged from 16% to 60% for seeds stored for nine days to those stored for one day. Lengths of seed storage, irrespective of seed coat treatment significantly affected germination of *C. albidum* seeds. *C. albidum* seeds cannot be stored for long time. Similar observations on seeds that can only withstand short period of storage have been reported by Idowu *et al*. (2013) (*Treculia africana).,* Jonathan and Olawole (2007) (*Treculia africana).,* Aduradola (2004) (*Piliostigma reticulatum)*., Okunomo (2010) and Koyejo and Okonkwo (2012) (*Tetrapleura tetraptera)*. Contrary to these reports are the findings of Baiyeri and Mbah (2006) who stated that *Treculia africana* seeds stored for three to six days before planting emerged earlier than those planted immediately after extraction from the fruit pulp or those stored for nine days.

Decrease in the germination rate of the *C. albidum* seeds after 5 days of storage showed that it cannot be stored for long time before it loses its viability because it is recalcitrant. Similar observations have been reported by Denton (1997) (*Chrysophyllum albidum*)., Tompsett (1992) (from *Shorea dasyphylla* to *Hopea hainanensis*)., Schmidt (2000) (*Azadirachta indica*)., Thomsen (2000) (*Hopea odorata*) and FAO *et al.* (2004) (*Araucaria* spp and *Agathis* spp). Recalcitrant seeds do not have the ability to stay alive for a long time. Recalcitrant seeds have short physiological storability, which can only be slightly extended by storing them under controlled conditions (Schmidt, 2000).

Table 1: Effects of duration of seed storage and seed coat treatments on germination potential of *Chrysophyllum albidum*

Treatments	Germination %	Days	Germination %
0	61a	1	60a
1	30b	5	34b
2	17c	9	16c
SE	1.15	SE	1.15

Trt 0 = control Trt 1 = sulphuric acid Trt 2 = clipping treatment
1 = Day 1 5 = Day 5 9 = Day 9
[abc] Means on the same row having different superscripts are significantly different (P<0.05).

Results interaction effect showed that percentage germination ranged from 0% to 86% for seeds stored for day 5 with and without seed coat treatments (Table 2). Highest significant germination percentage of 86 was recorded in seeds stored for 5days with no seed coat treatment. Seed coat treatment and increased lengths of seed storage did not enhance germination of *C. albidum* seeds. Sulphuric acid treatment did not enhance germination of *C. albidum* seeds partly because of the destructive penetration of seed coat to destroy embryo by the acid. Sulphuric acid was not able to scarify seed coats and softening seed coat to accelerate water uptake which results in earlier and faster germination. This is in line with the reports of Atiku *et al*. (2013) (*Acacia seyal*)., Adeogun and Solomon (2013) (*Phoenix dactylifera*)., Igboanugo *et al.* (2010) (*Etanda gigas*)., Okunomo (2010) (*Tetrapleura tetraptera*)., Aduradola and Adejumo (2005) (*Erythrophleum suaveolens*)., Ajiboye *et al*. (2009) (*Parkia biglobosa*)., Afrasyab and Reza (2007) (*Ferula gummosa*)., Salami and Salami (2009) (*Adansonia digitata*)., Mandujano *et al.* (2005) (*Opuntia rastrera*)., Zarchini *et al*. 2011) (*Cycas revoluta*) and Michael *et al*. (2008) (*Terminalia sericea*).

On the other hand, El-siddig *et al*. (2001) reported the effectiveness of acid treatment on seed germination. Acid treatments have been found to be effective for seeds of several tree species such as *Lupinus campestris* (Pedro *et al*., 2010)., *Tamarindus indica* (Mohammad and Amusa, 2003)., *Piliostigma reticulatum* (Aduradola, 2004)., *Delonix regia* (Akande *et al*., 2010)., *Prosopis africana* and *Dialinum guineense* (Ajiboye and Agboola, 2008)., *Aconitum heterophyllum* (Pandey *et al.,* 2000)., *Parkia biglobosa* and *Albizia lebbeck* (Ajiboye *et al.,* 2009)., *Acacia auriculiformis* (Olatunji *et al*., 2012)., *Acacia sieberiana* (Atiku *et al*., 2013)., *Canna indica* (Joshi and Pant, 2010)., *Acacia fistula* (Amira and Mohamed, 2013)., *Afzelia africana* (Amusa, 2011)., *Adansonia digitata* (Falemara *et al*., 2013)., *Dacryodes edulis* (Agbogidi *et al*., 2007)., *Asparagus racemosus* (Gupta, 2002)., *Lupinus varius* (Karaguzel *et al.,* 2004)., *Calligonum* species (Ren and Tao (2004)., *Tetracarpidium conophorun* (Ehiagbonare and Onyibe, 2007)., *Zizyphus spinachristii* (Aduradola, 2000)., *Cassia auriculata* (Negi *et al*., 2011)., *Cassia siamea and Cassia roxburghii* (Al-Menaie *et al*., 2009)., *Passiflora edulis* seeds (Mabunza *et al*.,2010) and *Parkia biglobosa* (Isah, 2012).

Mechanical scarification did not enhance the germination of seeds of *C. albidum* because it damages the endosperm as well as embryo during treatment. Contrary to this report are the findings of various investigators as Isah (2012) (*Parkia biglobosa*)., Olujobi *et al.* (2009) (*Afzelia africana*)., Morteza *et al*. (2011) (*Citrullus cococynthis*)., Aduradola *et al.* (2005) (*Chrysophyllum albidum*)., Aliero (2004) (*Parkia biglobosa*)., Sxitus *et al.* (2003) (*Ulex europaeus*)., Uzen and Aydin (2004) (*Ferula gummosa*)., Nadjafi *et al.* (2006) (*Teucrium polium*)., Okunlola *et al.* (2011) (*Parkia biglobosa*)., Babatunde (2004) (*Chrysophyllum albidum*)., Dogon Daji (2002) (*Tamarindus indica*, *Adansonia digitata* and *Acacia nilotica*)., Hossain *et al*. (2005) (*Terminalia* species)., Michael *et al.* (2008) (*Terminalia sericea*)., Akinnifesi *et al.* (2007) (*Sclerocarya birrea*)., Jun and Ling (2004) (*Calligonum* species) and Oyun *et al*. (2005) (*Tamarindus , Prosopis africana* and *Parkia biglobosa*) that further confirmed the efficacy of mechanical scarification in releasing seed dormancy.

Table 2: Interaction effects seed coat treatments and duration of seed storage on germination of *Chrysophyllum albidum*

Parameters	Treatments								
	0			1			2		
Days	1	5	9	1	5	9	1	5	9
% Germination	74b	86a	23c	59ab	0d	3c	20c	13c	19c
SE	1.99	1.99	1.99	1.99	1.99	1.99	1.99	1.99	1.99

[abc] means on the same row having different superscripts are significantly different (P<0.05)

CONCLUSION

Investigation conducted into the storability and pre-sowing treatment of *C. albidum* seeds for biodiversity conservation revealed that it cannot be stored for more than 5 days in ambient temperature before germination percentage start decreasing.

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