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ASSESSMENT OF PERIODS OF SAND PRIMING AND HYDRO-PRIMING ON THE GERMINATION OF AFRICAN EBONY (*Diospyros mespiliformis* Hochst)

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ABSTRACT

Diospyros mespiliformis (Hochst) is a multipurpose, agro-forestry tree species with diverse environmental and ecological significances. However, low percentage germination associated with its seeds has limited its domestication. To overcome this challenge, there is need to adopt cheap, fast, safe, natural and adoptable physiological techniques such as sand priming and hydro-priming. There is paucity of quantified information on natural and safe methods of relieving dormancy as sand priming and hydro-priming. Most of methods of breaking dormancy as use of acid are not simple, safe and adoptable by farmers who practices agro-forestry. In the light of this, these experiments were conducted to assess the periods of sand priming (0, 2, 4, 6 and 8 weeks) and hydro-priming (0, 2, 4, 6 and 8 weeks) on the germination of *D. mespiliformis*. Both experiments were laid down in completely randomized design with four replicates. Mean germination times were calculated, and result revealed that a significant increase in percentage germination was recorded with increasing periods of exposing seeds to sand priming up to four weeks. The percentage germination ranged between 28%-93.25% for control (0) and four weeks sand priming respectively. Least value of 8.92 day was recorded for mean germination time of control (0 sand priming). A significant increase in percentage germination was recorded with increasing hours of hydro-priming up to 24 hours. The percentage germination was ranged between 25% - 100% for control (0) hour to 24 hours. Highest germination percentages were recorded in seeds subjected to sand priming for 4weeks (93.25%) and those hydro-primed for 24hours (100%). These results are recommended for mass production of *D. mespiliformis* in agro-forestry nurseries.

Keywords: Agro-forestry**,** Dormancy, Multipurpose tree, Priming, Germination

INTRODUCTION

Diospyros mespiliformis is a deciduous savanna tree of Africa that belongs to the family Ebenaceace. It is called Africa ebony and Mgula Kanyaa in English and Hausa respectively (Thompson and Walter, 2007). The generic name *Diospyros* means divine and the specific name *mespiliformis* is derived from two words, (mesos) meaning half and (pilos) which are bullets. It is extremely widespread,

occurring from Senegal east to Eritrea, Ethiopia and Kenya, and south Namibia, northern South Africa and Swaziland, but it is nearly absent in the more humid forest zones of West and Central Africa. Trial planting for fruit production exists in Israel, and Southern part of the United State (EL-Kamali, 2011).

Various parts of the trees are used for food and in traditional medicine (Chivandi *et al.,* 2009; EL-Kamali, 2011), construction, musical instrument, sources of energy for cooking, forage for animals, aesthetic and raw materials for industry (EL-Kamali, 2011). In spite of enormous benefits of *D. mespiliformis*, it faces low domestication rate, as a result of problems associated with its seed germination. Most of the methods of breaking dormancy in seeds of agro-forestry tree species, such as the use of acids, are not safe, natural and adoptable by farmers as the use of sand priming and hydro-priming. Hydro-priming is the key to enhance fast germination, uniform emergence and resistance to inadequate environmental factors that control seed germination (light, temperature and water) (Adelani *et al.,* 2014a).

Seed priming is a pre-sowing strategy to influence seedling development by modulating pre-germination metabolic activity, prior to emergence of the radicle and generally enhances germination rate and plant performance (Hafsat and Singh, 2009). Seed priming is a procedure in which seed is soaked and then dried back to its original water content (Harris, 2002). Priming may help seed production in the tropics by ensuring that seedlings grow uniformly and vigorously (Harris *et al.,* 2001). There is dearth of quantified information on priming seeds of forest tree species compared to that of agricultural crops. In light of this, these experiments were conducted to assess the effect of sand priming and hydro priming on the germination of *D. mespiliformis* seeds.

MATERIALS AND METHODS

Experimental site

The research was conducted in the nursery of Federal College of the Forestry Mechanization, Afaka Kaduna. This is located at the Northern Guinea Savanna ecological zone. It is situated at about 30km along Kaduna Lagos road in Chikun Local Government Area of Kaduna State, Nigeria. The Garmin GPS 72 model was used to determine latitude 10^{o} 35^{1} and 10^{o} 34^{1} and longitude 7^{o} 21^{1} and 7^{o} 20^{1} (Adelani, 2015). Rainfall is approximately 1000 mm annually with the lowest monthly relative humidity averaging 29%. The vegetation is open wood land with tall trees; usually with small boles and broad leaves (Otegbeye *et al.*, 2001).

Fruit collection and materials

The fruits were sourced from the mother tree of *D. mespiliformis* in Kaduna. The seeds were extracted from the fruits and air dried. The randomly picked samples of seeds were cut open to assess the viability through cutting method (Schmidt, 2000). Sand was collected from the floor of College dam and sterilized in the Biological laboratory at 160^{o}C hours (Adelani *et al.,* 2014b). The poly bags of 20 x 25 x 25 cm^{3} were filled with the sterilized sand and in the screen house.

Experiment 1: Effect of sand priming periods on the germination of *D. mespiliformis* seeds

The effect of sand priming periods on the germination of *D. mespiliformis* seeds for (0, 2, 4, 6, 8 weeks) was assessed using a completely randomized design with four replications. The initial moisture content of the samples

of the seeds was determined by weighing the seeds on Mettler Top Loading Weighing Balance (Model-Mettler PM 11-K) before and after drying to constant weight (Adelani, 2015). The wet sand (about 200ml of water to 800g of sand) was packed in 3 liter polythene bags and the seeds broadcast into the bag. The bags containing the seeds and sand were tied at the ends, put in the sun and their orientation altered at 12.00pm daily to ensure uniform distribution of high temperature during the day. Moist sand conducted heat from sunlight to seeds in the bags. Thermometer was used to monitor changes in temperature during afternoon and late evening hours. There were four replicates for each treatment. A total of 16 bags, four per treatment times were opened fortnightly for twenty minutes for counting germinated seeds. The freshly extracted seeds that were not subjected to periods of sand priming served as control. Ten seeds were broadcast into a bag representing a replicate. Seeds removed from sand priming were air dried to constant weight for five days. Forty (40) seeds from sand priming poly bags were later planted in 4cm depth of sand in 20x5x5cm^3 bags. Seventy (70) ml of water per seeds was applied at two days interval (Adelani, 2009). The number of seeds that germinated fortnightly was recorded for eight weeks. Seeds were considered to have germinated after development of plumule. Percentage germination was expressed as the total seed germinated per total seeds sown multiplied by 100.

Experiment 2: **Effect of hydro-priming on germination of *D. mespiliformis* seeds**

A total of 960 *D. mespiliformis* seeds were extracted from the fruits, washed and air dried. The initial moisture content of the samples of the seeds was determined by weighing the seeds on Mettler Top Loading Weighing Balance (Model-Mettler PM 11-K) before and after drying to constant weight (Adelani, 2015). Sixty (60) seeds represented a replicate. Four replicates each was soaked in water for 12, 24, 36, and 72 hours. Each of the four replicates was removed from water after 12 hours and dried back to the initial constant weight before soaking. Each four replicates was planted in 4cm depth of 20 x 25 x 25cm^3 poly bags filled with sterilized river sand. Two hundred (200) ml of water per seeds was applied at two days interval (Adelani, 2015). The percentage germination and mean germination time were recorded as in experiment 1. Seeds were considered germinated after development of plumule. Percentage germination was expressed as the total seed germinated per total seeds sown multiplied by 100.

Germination Percentage and Mean Germination Time

Percentage was computed using the following formula

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

Mean germination time was calculated using the relation

$$\text{MGT} = \frac{\sum(f_x)}{\sum x}$$ Schelin *et al.* (2003)

Where, x is the number of newly germinated seeds on each day and f is the number of days, after seeds were set to germinate (the total number of days seeds spent to germinate). X is the total number of seeds that germinated at the end of the experiment. Germination percentage and mean germination time were recorded at two days interval

for 8 weeks.

Data analysis

The results of the germination experiments were analyzed for statistical significance (one way ANOVA) from the statistical software package for personal computer (Statsoft, 1993). All percent germination data were arcsine-square root transformed prior to analysis (Akindele, 2004). Multiple comparisons of means were made with "Least Significant Difference (LSD)" test at the 5% level.

RESULTS AND DISCUSSION

Effect of sand priming on the germination of *D. mespiliformis* seeds

Effect of sand priming on the germination percentage of *D. mespiliformis* seeds is presented in Table I. A significant increase in percentage germination was recorded with increasing periods of exposing seeds to sand priming for four weeks. The percentage germination ranged between 28%-93.25% for control (0) and four weeks sand priming respectively. Highest germination percentage value of 93.25% was recorded in seeds exposed to four weeks sand priming. This is an indication that four weeks is the optimum period of sand priming for *D. mespiliformis* seeds. The least mean germination time of 8.92 days was recorded for *D. mespiliformis* seeds exposed to 2 weeks of sand priming.

Table 1: Effect of sand priming on the germination of *D. mespiliformis* seeds

Sand priming	Percentage Germination	Mean Germination time (Day)
0	28.00c	9.00bc
2	66.50b	8.92c
4	93.25a	12.47a
6	80.00ab	10.70b
8	93.25a	12.47a
SE+	11.23	0.03

*Mean of the same column having different superscript are significantly different ($P<0.05$)

A significant increase in percentage germination was recorded with increasing hours of hydro-priming up to 24 hours (Table 2). The percentage germination ranged between 25% - 100% for control (0) hour to 24 hours respectively. Highest germination percentage value of 100% was recorded for *D. mespiliformis* seeds hydro primed for 24 hours. It can be deduced that 24 hours hydro-priming of *D. mespiliformis* seeds was appropriate treatment time to achieve optimum germination. Akinola *et al.* (2000) reported that higher duration of priming resulted in higher cumulative germination in wild sunflower. Caseiro *et al.* (2004) found that hydro-priming was the most effective method for improving seed germination of onion, especially when the seeds were hydrated for 96 hours compared to 48 hours. Positive effects of seed priming on seed invigoration depend on priming duration (Ashraf and Foolad, 2005).

The germination percentage of seeds that ranged from 25% to 100% showed that the hydro-priming is effective in enhancing germination of *D. mespiliformis* seeds. The reports by Stofella *et al*. (1992) (pepper)., Fujikura *et al.* (1993) (cauli flower)., Singh (1995) (sunflower)., Bailly *et al*.(2000) (sunflower)., Shivankar *et al*. (2003) (sunflower)., Ajouri *et al.* (2004) (barley)., Kaya *et al.* (2006) (sunflower)., Mubshar *et al.* (2006)

(sunflower)., Abdulrahmani *et al.* (2007) (barley)., Ghassemi-Golezani *et al.* (2008a) (Lentil)., Ghassemi-Golezani *et al.* (2008b) (Lentil)., Pirasteh-Anosheh and Hamidi (2013) (rape seeds) and Peter-Onoh *et al.* (2014) (*Maesobotrya barteri*) have shown the efficiency of seed hydro-priming in improving the seed germination percentage, enhancing early seedling emergence as well as improving seedling growth.

The *D. mespiliformis* seeds hydro-primed for 0, 12, 24, 36 and 72 hours had mean germination time of 10.36, 33.95, 44.61, 34.03 and 39.70 days respectively. The least mean germination time of 10.36 days was recorded for *D. mespiliformis* seeds not hydro-primed. Untreated seeds did not require time to recover from changes and reaction that took place in hydro-primed ones. Control germinated faster than hydro primed seeds. The least mean germination time of 21.94 days was recorded for *Balanites aegyptiaca* seeds not hydro-primed (Adelani, 2015). Contrary to the result of this study, Ghassemi-Golezani (2010b) reported that the lowest mean germination time, highest germination percentage and seedling dry weight of Pinto bean were achieved with 7 and 14 hours priming duration which was significantly different from 21 hours of hydro-priming. The probable reason for early germination of primed seeds may be due to the completion of pre-germination metabolic activities making the seed ready for radicle protrusion and the primed seed germinated soon after planting compared with untreated dry seed (Arif, 2005). Similar observation was reported by Peter-Onoh *et al*. (2014) who stated that priming improved the coefficient velocity of emergence of *Maesobotrya barteri.* Early germination of primed seeds over other treatments is probably due to water and gases entering the embryo early through the cracks and causing a series of enzymatic breakdown and resulted in the transformation of the embryo into a seedling early enough than other seed treatment. Primed seeds had lower mean emergence time (MET) compared with unprimed seeds (Peter-Onoh *et al*., 2014). These positive effects are probably due to the stimulatory effects of priming on the early stages of germination process by mediation of cell division in germinating seeds (Sivritepe *et al.,* 2003).

This result is in consonance with the report of Farooq *et al*.(2006) who stated that significant improvement in the growth of the emerging seedlings (root and shoot) may be attributed to early germination induced by primed over unprimed seeds, which resulted in vigorous seedlings with more root and shoot length than the seedling from unprimed seeds. Hamdollah (2013) also reported seed priming has been used to improve germination, reduce seedling emergence time and improve stand establishment and yield.

Table 2: Effect of hydro-priming on the germination of *D. mespiliformis* seeds

Hydropriming	Percentage Germination	Mean Germination time (Day)
0	25.00c	10.36c
12	80.00b	33.95c
24	100.00a	44.61a
36	80.00ab	34.03b
72	93.2a	39.70a
SE+	6.69	0.03

*Mean of the same column having different superscript are significantly different (P<0.05)

CONCLUSION

One of the major concerns in agro-forestry nurseries in the tropics is the lack of adequate information on the cheap, easy, adoptable pre-sowing treatments such as hydro-priming and sand priming which enhance seed germination and healthy seedling growth of tree species. New initiatives in agro-forestry are seeking to promote poverty alleviation and environmental rehabilitation through adoptable and efficient pre-sowing treatments such as hydro priming and sand priming. The assessment of the effect of hydro-priming and sand priming on the germination of *D. mespiliformis* seeds revealed that four (4) weeks of sand priming (93.25%) and 24hours hydro-priming (100%) gave highest germination percentages. Four weeks of sand priming and 24hours hydro priming are recommended for nursery men as well as poor farmers who engage in regeneration programmes.

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