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EFFECT OF SOURCES AND PERIODS OF ORGANO-PRIMING ON THE GERMINATION OF *VITEX DONIANA* SWEET SEEDS

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ABSTRACT

There is paucity of quantified information on the simple, safe and natural methods of breaking the dormancy of Vitex doniana seeds. In this light, investigation was conducted on organo-priming which is the use of organic materials in priming in order to break the dormancy of V. doniana seeds, at the screen house of Federal College of Forestry Mechanization, Afaka, Kaduna State, Nigeria during 2018 dry season. The solutions of the leaves of nitrogen fixing trees are sources of organic materials used in organo-priming. Effect of sources (Prosopis africana, Jacaranda mimosifolia, Pentaclethra micropylla, Vitex doniana, Enterelobium cyclocarpum, Casuarina equisetifolia) and periods (0, 6, 12, 18 and 24 hrs) of organo-priming on the germination of V. doniana seeds was laid down in split-plot experimental design with five replicates. A significant germination percentage value of 64 % was recorded in seed organo-primed in J. mimosifolia and P. microphylla. The least mean germination time of 3.2 days was recorded in seeds soaked in E. cyclocarpum. A significant germination percentage value of 100% was recorded in seeds organo-primed in J. mimosifolia for 18 hours. Organo-priming significantly (P<0.05) enhanced the germination of V. doniana seeds. The research therefore recommends organo-priming of V. doniana seeds in solution of leaf litter of J. mimosifolia for 18 hours.

Key words: Soaked, Primed, Dormancy, Natural, Germination

INTRODUCTION

The developing nations including Nigeria are endowed with many indigenous fruits that are of great importance to the rural communities (Okunlola and Akinyele, 2017). Fruits are referred to as juicy seed bearing structure of flowering plant that may be eaten as food. According to Okafor (2010), the contributions of wild fruits, nuts, seeds, vegetables and other classes of edible forest products and their potential in overcoming or ameliorating prevailing food problems are enormous. According to Pye-Smith (2010), there are around 3000 species of wild fruits in Africa representing enormous important and largely untapped natural resources. *Vitex doniana* is one of such indigenous fruit tree species of immense potentials.

Vitex doniana is called Black plum; Dinya; Ucha koro and Oori-nla in English, Hausa, Igbo and Yoruba respectively (Orwa *et al.*, 2009). It belongs to the family Labiatae. The blackish pulp of the matured fruits is sweet and edible, and is eaten fresh. This pulp also serves in jam preparation. A beverage is made from the fruit juice, whereas boiled fruits are the basis for an alcoholic liquor and wine (Ky, 2008). The *V. doniana* is an important indigenous fruit or leafy vegetable in Africa (Burkill, 2000; Maundu *et al.*, 2009) for food, medicine and other purposes (Dadjo *et al.*, 2012). Hounkpèvi *et al.* (2018) stated that its leaves are used as fodder for livestock and the young leaves as leafy vegetables in sauces preparation. The blackish pulp of its ripened fruits is edible and used in preparation of some sweet drinks (Hounkpèvi *et al.*, 2018).

Hounkpèvi *et al.* (2018) stated based on its socio-economic importance, its integration into the farm production systems could foster domestication

strategies and reduce anthropogenic pressures on its natural populations. The *V. doniana* seeds are dormant (Oboh and Igharo, 2017). Dormancy is a state where seeds do not germinate when placed under conditions which are normally regarded as favourable for germination (Ajiboye, 2010). Baskin and Baskin (2004) defined a dormant seed (or other germination unit) as one that does not have the capacity to germinate in a specified period of time under any combination of normal physical environmental factors (temperature, light/dark among others) that otherwise is favourable for its germination.

Seed dormancy remains a bottleneck to the propagation of many forest species of economic importance, since about 70 % of all major taxonomic groups of seed plants have dormant seeds (Baskin and Baskin, 2003). The *V. doniana* seeds present a combination of physical (PY) and physiological dormancy (PD), based on classification by Baskin and Baskin (2004) and Silveira (2013). However, little is known about dormancy breaking requirements and no reliable technique is available yet. Imbibition tests revealed that *V. doniana* seeds are physically dormant (N'Danikou *et al.,* 2014) but different treatments tested so far resulted in germination rates below 60% after six months (Mapongmetsem, 2006; Ky, 2008; Ahoton *et al.*, 2011). Uniform germination is one of the important agronomic requirements for successful domestication of wild harvested economic plants (N'Danikou *et al*., 2015).

Priming is one of the methods of ensuring uniform germination. Seed priming is a method to promote rapid and uniform germination of seeds, by controlling imbibitions to an extent where germination is initiated, but insufficient to cause radical emergence (Schmidt, 2000). Most of the methods of pre-sowing treatment such as physical, chemical and mechanical scarification only degrade the seed coat for germination (Aliero, 2004; Abubakar and Muhammad, 2013); without, always, rapidly and uniformly influencing the physiology of the seeds (Dewir *et al.,* 2011) and seedlings (Gehlot and Kasera, 2012) as well as not overcoming physiological dormancy of seeds (Habib *et al.,* 2015).

In light of this, this experiment was conducted to assess the effect of sources and periods of organo-priming on the germination of *V. doniana* seeds. Nutrient in organic materials dissolve during watering and available to seeds to enhance the physiology of the embryo as well as relieving seeds from dormancy for germination to take place (Adelani *et al.,* 2018). Relieving seeds of physiological (Adelani *et al.,* 2014a), physical and mechanical dormancy encourage mass production of seedlings for agro-forestry systems (Adelani *et al.,* 2018).

MATERIALS AND METHODS

Experimental Site

The research was conducted in the screen house of the Federal College of Forestry Mechanization, Afaka, Kaduna State. The college is located in the Northern Guinea Savannah ecological zones of Nigeria. It is situated in Igabi Local Government Area of Kaduna State, Nigeria. It lies between Latitude 10^{o} 35′ and 10^{o} 34′and Longitude 7^{o} 21′and 7^{o} 20′ (Adelani, 2015). The mean annual rainfall is approximately 1000mm. The vegetation is open woodland with tall broad leave trees (Otegbeye *et al.,* 2001).

Fruit Collection and Seed Extraction

The fruits of *V. doniana* were sourced from the mother tree in Buruku Forest Reserve, Kaduna State of Nigeria. The seeds were extracted from the fruits and air dried for thirty minutes. Three hundred seeds were extracted from their fruits. The viability of the randomly selected seed samples was assessed using the cutting method (Schmidt, 2000). The river sand used for the experiment was collected from the floor of the college dam and made to pass through 2 mm sieve (Adelani and Bello, 2016) and then sterilized in the laboratory oven at 160 ^{o}C for 24 hours (Adelani and Joseph, 2014; Adelani and Maisamari, 2016). The polythene pots used was 20 x 10 x 10 cm^3 in dimension and filled with the sterilized river sand and arranged in the screen house.

Chemical Analysis of Leaves of Nitrogen Fixing Trees

Each sample of pulverized leaves of nitrogen fixing tree species was analyzed chemically for nitrogen, phosphorus and potassium (NPK) content at the Federal University Agriculture Abeokuta laboratory. Determination of total nitrogen was done by Macro Kjeldahi method. Available phosphorus (P) was extracted by Bray-1 method

and determined colourimetrically. Extracts from the digestion of the leaves of the agro-forestry tree species were used to determine potassium by flame photometry. The dry weights of the agro-forestry species were determined, by the use of Mettle Top Loading Weighing Balance (Model-Mettler PM 11-K), after oven dried at 70 ^{o}C for 72 hours in accordance with (Umar and Gwaram, 2006).

Experimental Design

The solutions of the leaves of nitrogen fixing trees were sources of organic materials used in priming known as organo-priming. The investigation on the effect of sources and periods of organo-priming on the germination of *V. doniana* seeds was laid down in split-plot experimental design with five replicates. The solution of the leaves of nitrogen fixing trees (*Prosopis africana, Jacaranda mimosifolia, Pentaclethra microphylla, Vitex doniana, Enterelobium cyclocarpum, Casuarina equisetifolia*) made up the main plot. Periods of soaking (0, 6, 12, 18 and 24 hrs) constituted the sub-plot treatment. 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. Two seeds represented a replicate. Three hundred (300) seeds were soaked in 0.5 % concentration of solution of the leaves of nitrogen fixing trees (*P. africana, J. mimosifolia, P. microphylla, V. doniana, E. cyclocarpum* and *C. equisetifolia*) for different periods (0, 6, 12, 18 and 24 hrs).

Stirring or bubbling was done to ensure uniform treatment and aeration. After each treatment, the seeds were removed, washed, air dried for 30 minutes and treated with fungicide (Vinclozolin). The seeds were also dried back to the initial moisture content. Treated seeds were planted in 4cm depth of the sterilized sand and 200 mL of water per pot was applied regularly at two days interval for eight weeks (Adelani *et al.,* 2014b). Seeds that were not soaked in the 0.5 % concentration of solution of leaves of nitrogen fixing trees served as control. A seed was considered to have germinated when the radicle was able to break open the seed coat and at the sight of plumule emergence.

For this experiment, germination percentage and mean germination time were calculated using the following formula (1 and 2) suggested by Schelin *et al*. (2003).

Germination percentage (%)

Germination percentage was computed using the formula:

$$\text{Germination Percentage} = \frac{Totalseedgerminated}{Totalseedsown} \text{ x } 100 \quad \ldots\ldots\ldots (1)$$

Germination percentage was recorded every two (2) days interval for 12 weeks when no more germination was recorded.

$$\text{MGT} = \frac{\sum(f_x)}{\sum x} \quad \ldots\ldots\ldots (2)$$

Where: x is the number of newly germinated seeds on each day; f is the numbers of days after seeds were set to germinate; X is the total number of seeds that germinated at the end of the experiment.

Data Analysis

The data was collected for seed germination and subjected to analysis of variance (ANOVA) using SAS (2003) software. Mean separation at 5% significant level of probability was carried out with use of Least Significant Difference (LSD).

RESULTS

Effect of Sources and Periods of Organo-Priming on the Germination of *V. doniana* Seeds

The result of the effect sources and periods of organo-priming on the germination of *V. doniana* seeds is presented in Table 1. A significant germination percentage value of 64 % was recorded in seed organo-primed in *J. mimosifolia* and *P. microphylla.* The least mean germination time of 3.2 days was recorded in seeds soaked in *E. cyclocarpum*. Germination percentage of seeds organo-primed for treatment periods was not significantly ($P<0.05$) different. The least mean germination time of 13.33 days was recorded in seeds soaked for 12 hours.

Table 1: Effect of Sources and Periods of Organo-Priming on the Germination of *V. doniana* Seeds

S.N.F.T.S	% germ	MGT(days)	Periods	% germ	MGT(days)
P. africana	32.00^{ab}	15.20^{b}	---	---	---
J. mimosifolia	64.00^{a}	24.00^{ab}	0	43.33^{a}	14.67^{b}
C. equisetifolia	56.00^{ab}	24.00^{ab}	6	43.33^{a}	20.67^{ab}
V. doniana	20.00^{ab}	6.40^{b}	12	30.00^{a}	13.33^{b}
E. cyclocarpum	12.00^{b}	3.20^{b}	18	63.33^{a}	24.00^{a}
P. microphylla	64.00^{a}	31.20^{a}	24	26.67^{a}	14.00^{b}
SE±	15.87	10.96	SE	18.51	8.96

*Means on the same column having different superscript are significantly different (P<0.05) vertically
Key: S.N.F.T.S- Sources of Nitrogen Fixing Trees Species, % germ- Percentage germination, MGT-Mean Germination Time

Interactive Effect of Sources and Periods of Organo-Priming on the Germination of *V. doniana* Seeds

The result of the interactive effect of sources and periods of organo-priming on the germination of *V. doniana* seeds is presented in Table 2. A significant germination percentage value of 100 % was recorded in seeds organo-primed in *J. mimosifolia* for 18hours.

Table 2: Interactive Effect of Sources and Periods of Organo-Priming on the Germination of *V. doniana* Seeds

S.N.F.T.S	Periods				
	0	6	12	18	24
P. africana	0.00^{a}	20.00^{a}	20.00^{a}	60.00^{a}	60.00^{a}
J. mimosifolia	80.00^{ab}	80.00^{ab}	20.00^{b}	100.00^{a}	40.00^{b}
C. equisetifolia	60.00^{a}	60.00^{a}	60.00^{a}	80.00^{a}	20.00^{a}
V. doniana	20.00^{a}	60.00^{a}	0.00^{a}	20.00^{a}	0.00^{a}
E. cyclocarpum	20.00^{a}	0.00^{a}	0.00^{a}	40.00^{a}	0.00^{a}
P. microphylla	80.00^{a}	40.00^{a}	80.00^{a}	80.00^{a}	40.00^{a}
SE±	24.38	24.38	24.38	24.38	24.38

*Means on the same rows having different superscript are significantly different P (<0.05) horizontally
Key: S.N.F.T.S- Sources of Nitrogen Fixing Trees Species

Interactive Effect of Sources and Periods of Organo-Priming on the Mean Germination Time of *V. doniana* Seeds

The result of interactive effect of sources and periods of organo-priming on the mean germination time of *V. doniana* seeds is presented in Table 3. The seeds with mean germination time of 0 days did not germinate. The least mean germination time of 8days was recorded in seeds soaked in *P. africana* and *J. mimosifolia* for 12 hrs. Seeds soaked in *V. doniana* and *E. cyclocarpum* for 18hours also gave least mean germination time of 8days.

Percentage NPK Composition

Percentage NPK composition of selected Nitrogen fixing tree species The result of percentage NPK composition of nitrogen fixing tree is presented in Table 4. Highest percentage values of 2.66 % and 1.96 % were recorded for nitrogen and phosphorus in *J. mimosifolia* and *V. doniana r*espectively. Highest percentage value of 2.08 % was recorded for potassium in *C. equisetifolia.* Similar observation has been reported by Adelani *et al.* (2014c) and Adelani *et al*. (2017).

Table 3: Interactive Effect of Sources and Periods of Organo-Priming on the Mean Germination time of *V. doniana* Seeds

S.N.F.T.S	Periods				
	0	6	12	18	24
P. africana	0.00^{c}	8.00^{c}	8.00^{c}	36.00^{a}	24.00^{b}
J. mimosifolia	24.00^{b}	40.00^{a}	8.00^{c}	32.00^{ab}	16.00^{bc}
C. equisetifolia	24.00^{ab}	32.00^{a}	24.00^{ab}	24.00^{ab}	16.00^{b}
V. doniana	8.00^{ab}	16.00^{a}	0.00^{b}	8.00^{ab}	0.00^{b}
E. cyclocarpum	0.00^{a}	8.00^{a}	0.00^{a}	8.00^{a}	0.00^{a}
P. microphylla	32.00^{a}	20.00^{b}	40.00^{a}	36.00^{a}	28.00^{ab}
SE±	8.85	8.85	8.85	8.85	8.85

*Means on the same row having different superscripts are significantly different (P<0.05) horizontally
Key: S.N.F.T.S- Sources of Nitrogen Fixing Trees Species

Table 4: Percentage NPK Composition

S.N.F.T.S	N %	P %	K %
P. africana	1.97	0.85	1.88
J. mimosifolia	2.66	0.68	2.02
P. microphylla	2.21	0.89	1.79
V. doniana	2.56	1.96	1.73
E. cyclocarpum	2.38	0.93	1.92
C. equisetifolia	2.63	0.96	2.08

Key: S.N.F.T.S- Sources of Nitrogen Fixing Trees Species

Table 5: Anova for Effect of Sources and Periods of Organo-Priming on the Germination of *V. doniana* Seeds

Source	Df	Ss	Ms	Fcal	Ftab
Total	149	333, 733.33	2239.82		
Block	4	4,399.997	1100.00	0.87ns	2.87
A	5	66,133.33	13226.67	1050*	2.71
Error (a)	20	25,200.003	1260.00		
B	4	25066.66	6,266.67	3.66*	2.47
AB	20	48,533.34	2426.67	1.42ns	1.68
Error (b)	96	164,400	1712.50		

Table 6: Anova for Effect of Sources and Periods of Organo-Priming on the Mean Germination Time of *V. doniana* Seeds

Source	Df	Ss	Ms	Fcal	Ftab
Total	149	79,733.33	535.12		
Block	4	2,666.66	666.67	1.11ns	2.87
A	5	15,125.33	3025.07	5.03*	2.71
Error (a)	20	12021.34	601.07		
B	4	2693.33	673.33	1.64ns	2.47
AB	20	7834.67	391.73	0.95ns	1.68
Error (b)	96	39,392	410.33		

DISCUSSION

A significant germination percentage was recorded in *V. doniana* seeds organo-primed in *J. mimosifolia* for 18 hours. The 18 hours is enough for seeds to absorb nitrogen for cell division, expansion and maturation which resulted into resumption of visible growth known as germination. Nitrogen is essential for seed germination. The highest composition of nitrogen recorded for *J. mimosifolia* accountable for its ability to enhance germination percentage of *V. doniana* seed organo-primed in it. This is in consonance with the reports of Adelani *et al.* (2017) who stated that significant performance of *A. auriculiformis* in enhancing the germination percentage of *Citrus sinensis* seeds was traceable to its highest composition of nitrogen.

The significant germination percentage recorded in seeds organo-primed in *J. mimosifolia* is traceable to its ability to release nitrogen which regulated developmental process as germination. Similar observation has been reported by Alboresi *et al.* (2005). *J. mimosifolia* contained nitrogen which has ability to improve water absorption and protein synthesis and equally promoted cell division and elongation of seeds. In the same trend, enhanced germinability of *V. doniana* seeds is traceable to enlarged embryos, higher rate of metabolic activity and respiration, better utilization and mobilization of metabolites to growing points caused by the presence of nitrogen. Similar observations have been reported by Afzal *et al.* (2002) and Adelani *et al.* (2017).

Moreover, the outstanding ability of *J. mimosifolia* to enhance germination could be adduced to nitrogen content which encouraged seed invigoration. This is in conformity with reports of Sasthri and Srimathi (2010). Highest percentage values were recorded for nitrogen, phosphorus and potassium in *J. mimosifolia, V. doniana* and *C. equisetifolia*, respectively. Similar observation has been reported by Adelani *et al.* (2014c) and Adelani *et al.* (2017).

CONCLUSION

Investigation from this study revealed that organo-priming of *V. doniana* seeds in solution of *J. mimosifolia* enhanced its germination percentage. The use of organic materials in priming known as organo-priming improved the germinability of *V. doniana* seeds. The improvement of germinability of *V. doniana* seeds helps in domestication as well as regeneration which increase biodiversity conservation and reforestation programme for agroforestry systems. In the long run, the accessibility of Nigerians to the ample benefits of the high physiological quality tree species will be increased**.**

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