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EFFECT OF GROWTH HORMONES ON THE GERMINATION OF SHEA-NUT (*Vitellaria paradoxa* C. F. Geartn) AFTER PRE-TREATMENT

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ABSTRACT

A trial on the influence of pre-treatments and growth hormones/solutions on the germination of Shea-nut (*Vitellaria paradoxa*) was carried out in September, 2001- February, 2002 at the experimental Research Farm of University of Agriculture, Makurdi, Nigeria. The aim of this trial was to find the possible ways in inducing the germination of *Vitellaria paradoxa* using growth hormones/solutions treatments. The coats of some Shea-nut (*Vitellaria paradoxa*) collected from a single tree in Makurdi in August, 2001 were cracked, some completely removed while others were left intact and subsequently soaked in de-ionized water, Indolebutyric acid (IBA), Stenberg (stock) solution, Coconut water and combination of IBA and Coconut water respectively for 24 hours and planted thereafter in perforated polyethylene bags filled with mixture of sand, loam and humus. The interaction between pre-treatment (intact, cracked and removed seed coats) and soaking in solutions (growth hormones) was highly significant (p=0.001). Soaking cracked nuts in de-ionized water was significantly effective in hastening the germination of *Vitellaria* seeds with 46 days to attainment of 50% emergence, a reduction from an average of 51-79 days. This indicates a significant difference from intact seeds soaked in coconut water, IBA; cracked seeds and removed coat seeds soaked in all the solutions with exception of intact seeds soaked in IBA + Coconut water and intact seeds soaked in Stenberg solutions with 53 and 60 days respectively. However, to avoid injury and damage on the growing region of the seeds during the process of cracking, soaking intact seeds in Stenberg solution was recommended for adoption because it is resistant to infection and is cost effective than all other solutions throughout the study period.

KEYWORDS: Pre-treatment, growth hormones, emergence, germination, *Vitellaria paradoxa*

INTRODUCTION

The Shea- butter tree *Vitellaria paradoxa* is an important oil tree in Nigeria, especially in the savanna zones (Awoleye, 1996). The trees grow in the wild as there is no single plantation of the crop in the entire country. It is a neglected tree despite the long tradition of use.

The kernels “Shea-nut” contain 45-65% by weight of fat (33% non-saturated and 67% saturated fat), (Leaky, 1999) and 9% protein (Maranz, *et. al.,* 2004). Shea- butter is generally used locally as a cooking fat (Umali and Nikiema, 2002), an illuminant, a medicinal ointment and is used for soap and candle making (Booth and Wickens, 1988). The bark of the tree, roots are useful in traditional medicine (Booth and Wickens, 1988). It is a hard and durable timber. The kernel, if not used locally is sold for export after drying (Popoola and Tee, 2001).

Despite all these uses and economic advantage, there are still no routine plantings of *Vitellaria paradoxa.* Little is known about the agronomy of this tree (Ugese, 2010). Production of Shea-nut is based on collection of fallen fruits from the wild. *Vitellaria paradoxa* tree flowers from December to March and fruits are harvest from May to September (Awoleye, 1996), which coincides with the planting of the main crops and inevitably competes for labour.

The difficulties facing establishment of *Vitellaria paradoxa* plantation include poor seed longevity and limited success encountered in using vegetative propagation methods to produce seedlings (Jackson, 1968). *Vitellaria paradoxa* nut have a short period of viability. This species has recalcitrant seeds which need to maintain high critical moisture content and it rapidly loss viability if they are dried (Baskin and Baskin, 2005). When nuts are planted immediately after collection, there is prolonged dormancy which takes between 51-79 days for shoots to emerge from the soil (Jackson, 1968) and (Ugese, 2010). The variability in the speed of emergence has consequences in establishment of Shea-nut plantation, and to circumvent this problem, pre-sowing treatment which include cracking and removal of seed coats (Jeff, 1986), (Agoola and Etejere , 1991) and (Khan, 1980) and treatment with growth hormones/solutions like IBA (USDA, 1989) and (Green *et al,* 1987), Coconut water (Vickery and Vickery, 1979), (Child, 1964) and(Woodroot, 1979), Sternberg solution (Lockwill, 1981), de-ionized water (Nwoboshi, 1982) are inevitable.

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In view of the above consideration, it has become very important to provide necessary information through research on how to break the dormancy of shea-nut, using hormone solutions, pre-treatment effects. The objective of this trial are:

(1) To break dormancy in shea-nut by hormone solution treatments.
(2) To determine which solution performed better and recommend same to farmers to help improve their production.

MATERIALS AND METHOD

Location

This trial was conducted in September, 2001-Februrary, 2002 at the experimental research farm of the University of Agriculture, Makurdi, Nigeria located on latitude 07^{o} 14‘ N and longitude 08^{o} 37‘ E. An average temperature of 35^{o} C with predominantly clay loam soil, and relative humidity of.70-85% (NIMET, 2001).

Experimental materials

Four hundred and fifty (450) fresh ripped fruits of *Vitellaria paradoxa* (Shea-butter) were collected between the months of August, 2002 from a single tree stand along Makurdi – Gboko road opposite Benue State University, Makurdi. The fruits were depulped and stored in an open air space under shade for 6-7 days to reduce the moisture content of the seeds.

A mixture of sand, loam and humus soil was collected into perforated polyethylene bags of 30 x 30 cm. An average weight of 2.5kg of soil was used to fill each perforated polyethylene bags to about 3/4 filled. A total of four hundred and fifty bags (450) were used.

Preparation of Solutions

- Stenberg (stock) solution:
  The following compounds were dissolved in 15 litres of de-ionized water:

Compound	Weight (g)
NH_4NO_3	0.408g
$Ca(NO_3)_2.4H_2O$	0.177g
NaH_2PO_4	0.348g
KCL	0.6648g
$MgSO_4$	1.05g
$Fe(NO_3)_2.9H_2O$	0.2748g
$MnCl_2.4H_2O$	0.0059g
H_3BO_3	0.00465g
$ZnSO_4.7H_2O$	0.00066g
$CuSO_4.5H_2O$	0.00058g
$NH_4MoO_4.2H_2O$	0.6187g

(Green, Harthy and West, 1987)

- **Indolebutyric acid (IBA)**
  15 litres of 1mg/litre of IBA solution was prepared by dissolving 15mg of Indolebutyric acid (IBA) in 15 litres of distilled water.
- **Coconut water**
  15 litres of fresh coconut water was collected from 753 coconut fruits, an average of 19.92ml/fruit.

IBA + Coconut water:

15 litres mixture of 0.5mg/litre IBA and ½ concentration of coconut water was prepared by mixing 7.5 litres of 1mg/litre of IBA solution and 7.5 litres of coconut water collected from another 376 fruits (equal volume of 1mg/litre of IBA solution mixed with equal volume of Coconut water).

One hundred and fifty seeds were selected from the total of 450 seeds collected from a single tree along Makurdi – Gboko road, makurdi Benue State, Nigeria. Fifty (50) intact seeds were further selected at random, 10 seeds each were soaked in distilled water, Stenberg (stock) solution, IBA, coconut water, and combination of IBA and coconut water, for 24 hours. Another fifty (50) seeds were selected at random, carefully cracked using hammer to avoid injury on the seeds, ten (10) each was soaked in the above solutions for 24 hours. For the remaining fifty (50) seeds, the coats were carefully removed and 10 seeds from each treatment soaked into each hormone solution for 24 hours.

Experimental design

The experiment was laid out in a 3x5 split-plot in Complete Random Design (CRD) replicated three times

(1) Main plots were:
  (a) Intact seed coat
  (b) Cracked seed coat
  (c) No seed coat

(2) Sub – plots were:
(a) De-ionized water
(b) IBA
(c) Coconut water
(d) Coconut water + IBA
(e) Stenberg Solution

The plot size was ten polyethylene bags giving a total of one hundred and fifty polyethylene bags or seeds per replication. Pre- sowing treatments (leaving seed coat intact, cracking seed coat, and removing seed coat) formed the main plot treatment while soaking in hormones/solutions (De-ionized water, IBA, Coconut water, IBA+ Coconut water and Stenberg solution) formed the sub-plot treatment. Treatments were randomly assigned to main plots and sub-plots accordingly.

A total of four hundred and fifty nuts were used in this experiment. Each soaked nut was removed from the solution and planted directly on each pot or polyethylene bag at the depth of 4cm deep with the scar surface of the seed facing the ground.

There was sufficient moisture for the crop during the planting season and at two days interval, watering was done during the dry season (October-February). The emergence of the seedling above the soil level was used as a basis of determining the germination. Records of the number of emergence were taken on daily basis – days after planting after the first emergence until 50% emergence in all the three replications.

Statistical analysis

Data obtained were analyzed using analysis of variance (ANOVA) for mean separation and the means were compared using a Fishers - Least Significant Difference (F-LSD) at 5% and 1% significance level (Mead and Curnow, 1983).

RESULT

Effect of Pretreatment on the Germination of *Vitellaria paradoxa*

Table I shows the effect of pre-treatment on the germination of Vitellaria seeds in which F- calculated values of main plot (intact, cracked and removed seed coat) was significantly ($p<0.01$) higher than the Table values (F-tab) And from Table II, cracked seeds had the least days of 67 to attain 50% emergence, followed by intact seeds with 72 days and 89 days for those without seed coats. The mean value of cracked and intact seeds do not show any significant ($p=0.05$) difference during the study period. However, the mean values of intact seeds and cracked seeds, 67 days and 72 days respectively were significantly ($p=0.05$) different from that of removed seed coat (89 days).

Effect of Growth Hormones on the Germination of *Vitellaria paradoxa*

Table I, shows the effect of growth hormones/solutions on the germination of Vitellaria in which the F- calculated value of the sub-plot (De-ionized water, Stenberg solution, IBA, Coconut water, and IBA + Coconut water)was significantly higher ($p<0.01$) than the Table value(F-tab). The results in Table II show that the use of Stenberg solution in soaking *Vitellaria* seeds was most effective having 63 days to attain 50% emergence and this was significantly ($p<0.01$) higher than the mean values obtained from either de-ionized water (73 days); coconut water (75 days); IBA (81 days); or IBA + coconut water (88 days). It was also found that there were significant differences between soaking in De-ionized water, coconut water and IBA. However, there was no significant difference between soaking in IBA and combination of IBA and coconut water.

Effects of Interaction between Pre-Treatment and Growth Hormones in the Germination of *Vitellaria paradoxa*

Table I, shows the effects of the interaction between pre-treatment and growth hormone in which the F calculated values of interaction effect was significantly ($p<0.01$) higher than Table value(F-tab). This indicates that the difference among the effects of growth hormones/solutions on the germination of *Vitellaria paradoxa* is dependent on the pre-sowing treatments (intact, crack and removal of seeds coat). In Table 3, the mean value of cracked seeds in de-ionized water gave the most effective treatment combination using 46 days to attain 50% emergence. However, the value did not show any significant ($p<0.05$) difference with those of intact seeds coat soaked in IBA+ Coconut water (53 days), Steinberg solution (60 days) and cracked seeds soaked in Steinberg solution (61 days). Moreover, removed seed coat treated with combination of IBA and Coconut water with 116 days to 50% emergence was the least effective in increasing the germination rate of *Vitellaria* plant. On the average, regardless of the pre-sowing treatment given to the nuts, use of Steinberg solution attained 50% emergence in 63 days. Hence intact nuts soaked in Steinberg (stock) solution and those soaked in combination of IBA and Coconut water were equally effective in increasing the rate of germination of *Vitellaria*.

Table 1: Analysis of Variance of the Effect of Pre-treatments and Growth hormones/Solutions in the Germination of Shea-nut seeds (*Vitellaria paradoxa*)

Source	Df	S.s	M.s	F-cal	F-tab 5%	1%
Replication	2	1006.53	503.27			
Main plot (A)	2	380680	1903.4	32.12**	6.94	18.00
Error (a)	4	237.07	59.27			
Subplot (B)	4	3031.56	757.89	8.55**	2.78	4.22
AXB	8	7966.97	995.87	11.24**	2.36	3.36
Error (b)	24	2127.07	88.63			
Total	44					

Table 2: Mean Effect of Pre-Treatment and Growth Hormones/Solutions on the Germination of *Vitellaria paradoxa*

	Treatments Sub-plots (B)						
Pre-treatment Main plot (A)	H_2O	IBA	Steinberg	Co/nut	IBA+Co	Mean (A)	FLSD 5% = 8
Intact seeds	94	86	60	67	53	72	
Cracked seeds	46	68	61	69	94	67	
Removed coats	79	90	68	90	116	89	
Mean (B)	73	81	63	75	88		
FLSD 5% = 9.12							

Table 3: Mean Interaction Effect (AxB) between Pre-treatments and Growth Hormones/Solutions on the germination of *Vitellaria paradoxa*

Seed treatment	H2O	Co/nut	IBA	Steinberg	IBA+Co
Intact seeds	94	67	86	60	53
Cracked seeds	46	69	68	61	94
Removed coat seeds	79	90	90	68	116
FLSD (p=0.05) = 16					

DISCUSSION

From the results of the analysis, cracking *Vitellaria paradoxa* nuts and soaking in de-ionized water for 24 hours proved to be effective in hastening germination. Similar observations have been reported by other authors (Agoola, 1995; Jackson, 1968). The authors also observed that cracking of *Prosopsis africana and Vitellaria paradoxa* seeds sufficiently ($p<0.05$) hastened their germination rate. Equaly, Nwoboshi, (1982) found that, soaking of seeds in water for 12 to 24 hours was most effective in hastening their germination.

Stenberg solution was found to be most effective for soaking *Vitellaria paradoxa* seeds when compared with other solutions for germination, probably due to its osmatic regulation activities, permeability of the membrane and acts as a catalyst (Kramer and Kozlowski, 1960). They further reported that Steinberg solution contains as many as sixteen essential plant nutrients which are required for an effective, metabolic activities, and catalytic reaction in plants.

Coconut water was found also to be effective as compared to IBA as it has been reported to contain factors promoting growth of young embryo in plants (Van Overbeek, *et al.,* 1941) and found to be more effective in combination with IBA compared to used alone (USDA, 1986). It also showed a decrease in its effectiveness as the solution gets more in contact with the seed. This could however be due to the concentration and duration of the soaking of the nuts which was earlier reported (Richard, 1996).

CONCLUSION

From the result of the study, it can be concluded that cracking and soaking of *Vitellaria* seeds in de-ionized water, soaking intact seeds in combination of IBA+ Coconut water and soaking either intact or cracked seeds in Stenberg solution have the potentials of hastening and ensuring uniform germination, even as soaking intact or cracked seeds in Stenberg solution become less effective in contact with the seeds. In addition, to avoid injury or damage on the growing regions of the seeds during cracking which may render the seeds susceptible to pathogenic attack, and for the high cost of Indobutyric acid and coconut water, soaking of intact nuts in Stenberg solution will be recommended for fast germination, and cost effectiveness with greater economic returns to the farmer. More research is needed with different concentration and duration levels of soaking *Vitellaria* seeds in Stenberg solution to determine if their efficacy could be improved upon.

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