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Research Article

Enhancing Germination, Growth and Development of Bitter Bush Mango (*Irvingia wombolu*) through Cold Storage and Growing Media

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Abstract
The study examined critically the influence of cold storage and growing media on the growth and development of *Irvingia wombolu* seed with the view of producing uniform seedlings with good vigour. Seeds of *Irvingia wombolu* were stored in refrigerator for 0, 4, 8, 12 and 16 days. Fifteen (15) polythene bags of 50 cm x 30cm size filled with each of the sowing media (topsoil and saw-dust). The statistical design adopted for this study was a 2 x 5 factorial design fitted into a completely randomized design (CRD) with three replicates. The result of germination revealed that there was no significant difference at $p<0.05$ growth media. However, seeds stored for eight days germinated first at 15days after planting, while top soil had 82%, saw-dust had 85%, followed by seeds stored for 12 days (16 DAP) with 80% in both sowing media. Cold storage for 8 and 12 days produced the tallest plants within the first 8 weeks after planting.It was also observed that seedlings in sawdust grew taller at the beginning than those in top soil but the trend was later reversed. The 0 , 8 and 12 days stored seeds produced the largest collar diameter seedlings throughout the sampling periods. Leaf number was more in 0 and 4days storage than in other treatments in both growing media. However, the topsoil produced more leaf number than those of sawdust. It can be concluded that for better germination and sustainable growth of *Irvingia wombolu*, the seeds should not be stored for more than 12 days and sawdust should be used for the germination of *Irvingia wombolu*, theseedlings should be transplanted to topsoil for sustainable growth and development.

Keywords: Bitter bush mango (*Irvingia wombolu*), Cold storage, Growing media, Growth and Development

Introduction

The Nigerian forest is richly blessed with many under-utilized fruit trees with high nutritional, economic and medicinal values. Rural dwellers live on these non-timber forest products which serve as food supplements, bring income and livelihood by their exploitation. These important trees could become extinct due to the over-exploitation of the forest products and deforestation. Nigeria deforestation rate is placed at over 80% of the global total (Meyers, 1989). At present, most of the indigenous food trees in the forest zone are over-exploited and not purposely cultivated (Isichei, 2005). Over exploration of the seeds and other plants parts will lead to extinction if proper silvicultural steps are not taken for its conservation. Loss and degradation of the forests is now recognized as a global environmental crisis, global forest area declines by around 20 million hectares per year, (Hansen *et al.,* 2010). There is therefore an urgent need for the conservation and domestication of nation's rich biodiversity because of rise in the population, environmental issues, poverty and unemployment. Among all the bio-resources that need conservation and domestication for the economic and social development of the citizenry, *Irvingiawombolu* quickly comes to mind.

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Irvingia wombolu commonly called bitter bush mango is found in the tropical rainforests of East, West and Central Africa (Tchoundjeu *et al*., 2005). The species is endemic in the Southern part of Nigeria and the lower region of the Middle Belt States (Nzekwe *et al.*, 2005). *Irvingia wombolu* fruit pulp is slimy to touch and bitter to taste (Ejiofor *et al*., 1987). The most desirable part of the species is the kernels. The cotyledons, popularly used in preparation of slimmy-soup called "Ogbolo" in Igbo and "Aapon" in Yoruba. The species flowers between October and December, while it fruits from January to March. In most localities, the peasant farmers generate substantial revenue by selling the kernels which are obtained from the fruits of the trees in the wild (Harris, 1996). It has enormous potential, both in economic terms and as species for sustainable production (Angie and Brown, 2001). The popularity of the kernels in the local and International markets has highlighted its potentials for a true commercial crop thus resulting in more intensive collection in the forests (Ladipo, 2000). Ladipo (1999) reported that the market for kernel products was worth in the region of US $50 million. This market which extends to local, regional and international levels is growing. The products are traded within Nigeria and between countries in West and Central Africa. They are also transported to Europe, United States, Japan and to other areas where African migrants abound in large numbers (Ladipo and Boland, 1994).

The successful domestication of indigenous forest tree species in meeting the needs of land users depend largely on how well the trees can be integrated into plantation. Therefore, there is need to domesticate and integrate them fully into farm land, or as enrichment planting inside the forest. The first step to this is to determine the appropriate method of producing uniform seedlings with good vigour. *I. wombolu*is a recalcitrant and is highly competed for by man and animal, which makes it difficult to have enough seed for planting as well as meeting human demands for consumption. Therefore, the study was aimed at investigating the appropriate cold storage time suitable for the germination of *I. wombolu*and the best sowing medium for germination of *Irvingia wombolu*for optimum production.

Materials and Methods

Seed collection and experimental procedure

Seeds of bitter bush mango (*I. wombolu)* were collected from a mother tree at Okhuesan in Edo state. The tree is known for production of good high quality seeds. The seeds were extracted; the damaged and smaller seeds were discarded. The good ones were further subjected to viability test using the floatation method. The viable seeds were selected for the study. Initial germination test was carried out. The selected seeds were stored according to the treatments. These were stored in refrigerator for 0, 4, 8, 12 and 16 days. The required number of seeds was gradually removed at the end of each duration according to treatment time and replicates. Six seeds were placed in each treatment including the control. Fifteen (15) polythene bags of 50 cm x 30cm size were filled with each of the sowing media and left in the nursery to settle. The seeds were sown in an already prepared polythene pots at six seeds per pot according to treatments and replicates. The seeds were sown at a uniform depth of 3cm. The polythene pots were watered daily. The experimental design adopted for this trial was a 2 x 5 factorial design fitted into a completely randomized design (CRD) with three replicates. Significant means were separated using Duncan multiple range test at 5% level of probability. The treatments were cold storage at 0, 4, 8, 12 and 16 days in refrigerator and the sowing media were topsoil (TS) and sawdust (SD).At the end of germination trials, the seedlings emerged were further studied for their growth and development from 6^{th} to 12^{th} weeks after sowing.

Parameters that were assessed:

Germination count: Physical counting of the emerged seedlings. Germination percentage estimated as:

$$Germination\ Percentage = \frac{\text{Number of emerged seedling}}{\text{Total number of seeds planted}} \text{ x 100 at the end of the 6th week after planting}$$

Mean days of germination: Total number of days it took the seedling to emerge.

Number of leaves: Physical counting of the leaves.

Seedling height (cm): This was done by the use of calibrated ruler to measure the height of each seedling weekly from sixth to twelfth weeks after planting.

Collar diameter: This was measured with the use of veiniercaliper (cm) weekly from sixth to twelfth weeks after planting.

Results and Discussion

Seed germination

The analysis of variance for the influence of cold storage and sowing media on germination of *Irvingia wombolu* seeds indicated that there were no significant differences between the sowing media which implies that any of the sowing media can be used for germination of *Irvingia wombolu*seeds. However the storage time and the interaction between sowing media and storage indicated significance at 5% level of probability which implies that the storage times used had a significant effect on the germination and growth of *Irvingia wombolu*seed.In both sowing media, seeds stored for eight days germinated first at mean day of 15 after planting (Table 1), top soil had 82%, saw dust had 85%, followed by seeds stored for twelve days (16 DAS) with 80% in both sowing media. However, statistical analysis indicated no significant difference between the soil types. The seeds in the control treatment had about the same results as those in 4 days cold storage treatment while the seeds stored for 16 days gave the least germination percentage of 48% in sawdust and 42% in topsoil. It is an indication that the seeds of *I. wombolu*germinates easily soon after collection and extraction but loses viability with time. The early germination of stored seeds over unstored treatments is probably due to water and gases permeability through the seeds coat which in turn caused a series of enzymatic breakdown that resulted in the transformation of the embryo into a seedling early enough than untreated seed

Seedling growth and development

The plant height, collar girth and leaf number of the seedlings were examined. It was also observed that seedlings in sawdust grew taller at the beginning than those in top soil, but this trend was reversed after the 10^{th} week (Table 2). Cold storage for 8 and 12 days produced the tallest plants within the first 8 weeks after planting in sawdust media while the trend continues in topsoil at 8-12 weeks after planting. Seeds stored for 8 days had lowest seedling height in both soil media. By the 10 – 12th week of the investigation, it was clearly observed that the top soil medium performed better than the sawdust. The result agreed with the work of Amber (2010) who also obtained highest seedlings height in top soil.The mean effect of cold storage and sowing media *on* collar diameter (cm) of *I. wombolu*seeds is presented in Table 3. The 0, 8 and 12 days stored seeds produced the largest collar diameter seedlings throughout the sampling periods. This result agreed with the work of Okunomo (2010) which also affirmed that top soil gave the highest performance of collar diameter.

Leaf number was more in 0 and 4 days storage than in other treatments in both growing media (Table 4). However, the topsoil produced more leafs number than those of sawdust (Table 4). The performance of top soil over sawdust could be indication that as the plants were growing older, the nutrient in the saw dust could no longer support the growing need of the plant.

Conclusion and Recommendation

Seeds of *I. wombolu* are recalcitrant that need to be sown as soon as seed extraction is carried out. However, the seeds can be stored in the refrigerator for a period not more than eight days for maximum germination of seeds. From the results of this investigation, one can easily advise both the *I. wombolu* farmers, nursery scientists and technicians that saw dust could be used to raise the seeds of *I.wombolu*and thereafter, topsoil could be used for sustainable growth and development.

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Table 1.Effect of cold storage and sowing media on seed germination and days of emergence of *I. wombolu*

Storage (Days)	Sawdust		Topsoil	
	Germination (%)	Mean days of germination	Germination (%)	Mean days of germination
0	74	18	75	18
4	74	18	75	19
8	85	15	82	15
12	80	16	80	16
16	48	27	42	28
SE	6.286	1.032	5.905	2.515
MEAN	72.2	18.8	70.8	19.2

Table 2. Mean effect of cold storage and sowing media on plant height (cm) of *Irvingiawombolu*

WAP	Saw dust pH					Top soil pH				
	0	**4**	**8**	**12**	**16**	**0**	**4**	**8**	**12**	**16**
6	12	11.3	12.8	12.3	9.8	9.9	10.2	11.6	11.9	9.3
7	13.5	12.6	15.7	16.3	9.9	10.6	10.8	12.9	14.1	9.6
8	14.3	13.9	16.3	16.5	10.6	14.1	12.2	14.3	16.2	10.5
9	16.8	14.7	17.7	18.8	10.8	15.4	14.3	16.9	18.3	11.3
10	19	14.9	19.6	20.4	11.5	19.3	16.8	19.3	22.2	11.6
11	20.2	15.5	23.3	23.6	11.8	21.8	18.7	24.2	25.6	12.8
12	22.8	18.9	25.5	26	12.1	24.2	19	26.3	28.1	13.5
SE	0.2867	1.361	0.864	0.493	1.507	0.081	0.899	0.807	0.729	0.987
MEAN	16.9	14.5	18.7	19.1	10.9	16.5	14.6	17.9	19.5	11.2

WAP= Weeks after planting, PH-Plant height

Table 3. Mean effect of Cold storage and sowing media *on* collar diameter (cm) of *Irvingiawombolu*seeds

WAP	Sawdust					Top soil				
	0	**4**	**8**	**12**	**16**	**0**	**4**	**8**	**12**	**16**
6	2.25	1.98	2.86	2.26	2.04	2.21	2.34	2.73	2.08	2.06
7	2.67	2.09	3.03	2.65	2.28	2.98	2.67	2.98	2.29	2.34
8	3.00	2.87	3.44	3.11	2.98	3.09	2.98	3.22	2.67	2.49
9	3.27	2.95	3.98	3.34	3.13	3.27	3.26	3.48	2.99	2.95
10	3.33	3.12	4.02	3.74	3.25	3.88	3.84	3.9	3.67	3.17
11	3.99	3.45	4.08	4.03	3.37	4.02	3.93	4.19	3.93	3.69
12	4.67	3.69	4.46	4.38	3.48	4.27	4.02	4.87	4.32	3.86
SE	0.546	0.290	0.188	0.159	0.246	0.240	0.156	0.238	0.146	0.159
MEAN	3.31	2.88	3.70	3.36	2.93	3.39	3.29	3.62	3.13	2.94

Table 4. Mean Effect of Cold storage and sowing media *on* number of leaves of *Irvingiawombolu*seeds

WAP	Sawdust					Top soil				
	0	**4**	**8**	**12**	**16**	**0**	**4**	**8**	**12**	**16**
6	8.78	9.26	7.23	8.17	7.76	8.67	8.89	8.02	6.67	7.87
7	9.56	9.88	7.81	8.79	8.00	9.88	9	8.34	6.82	7.89
8	10.79	10.23	7.97	9.28	8.43	10.02	9.38	8.69	6.98	8.11
9	12.63	10.85	8.21	9.92	8.56	10.6	9.9	8.93	8.24	8.88
10	12.9	13.61	8.65	11.8	9.1	13.3	12.2	9.45	8.96	9.16
11	13.06	13.82	9.87	12.07	9.23	13.9	12.8	9.87	10.02	89.64
12	13.86	14.0	10.09	12.69	9.38	14.2	14.4	10.65	12.84	9.92
SE	0.620	0.930	0.866	0.379	0.315	0.155	0.615	0.491	0.226	2.331
MEAN	11.65	11.66	8.55	10.39	8.64	11.51	10.94	9.14	8.65	20.21

Table 5. Effect of growing media on plant growth and development of *Irvingiawombolu*

Growing media	Plant height	NOL	CD
Top soil	2.71**	5.98**	1.72
Saw dust	1.28	4.44**	0.87

NOL – Number of leave
CD – Critical difference