Effect of Seed Pre- Germination Treatment and Light Regimes on The Germination and Growth of *Myrianthus Arboreus* (P. Beauv) Seedlings

E. G. Oboho, F. F. Omake, and E. L. Anozie

Abstract — The effects of seed pre-treatment methods on the germination and growth of *Myrianthus arboreus* under two light regimes was conducted in the nursery of the Department of Forest Resources and Wildlife Management, University of Benin, Benin City. The seed pre-treatment methods were 24 hours soaking in water (T1), 12 hours soaking in water (T2), seeds tied in black nylon (T3), control no treatment (T4) and repeated under two light regimes which were open light regime and medium light regime. Experiment was set up in Completely Randomized Design manner (CRD.) Analysis of variance was used to analyze the results of germination and growth parameters measured.

Germination percentages in the open light regime were 52, 56, 52 and 56% for T1, T2, T3, and T4 respectively while germination percentage in the medium light regime were 100, 64, 0 and 32% for T1, T2, T3, and T4 respectively. The mean shoot heights (cm) were 10.22 and 5.36 in the open light regime and medium light regime respectively. Collar girths (mm) were 1.99 and 1.11 number of leaves were 3.39 and 2.23 while the mean shoot to root ratio was 1.01 and 0.99 for the open light regime and the medium light regime respectively.

Therefore, it is recommended that the seeds of *Myrianthus arboreus* be soaked in water for 24 hours, sown under medium transferred at the 2-leaf stage to the open light regime (or shading removed) where they will grow until planting out time.

Index Terms — Growth, light, *Myrianthus arboreus*, pre-germination treatment, seeds.

I. INTRODUCTION

Seed is crucial to regeneration. [1] indicated that seed is a key element in plant production that exercise a very great influence on the success or failure of both natural and artificial regeneration. Seeds of many tree species germinate readily when subjected to favourable conditions of moisture and temperature, others possess some degree of seed dormancy. Dormancy is a state of suspended activity in a seed. There is extremely low metabolic and reduced physiological activity at this stage. Seed germination can be hindered by physiological, physical and morphological forms of dormancy and some species could be hindered by one or both forms [2]. Where dormancy is strong, some form of seed pre-treatment is necessary in order to obtain a reasonably high germination rate within a short time. The decision whether or not to pretreat seed could vary with the

species and provenance, seed year, local nursery conditions, length and conditions of storage. The method of pre-germination treatment used depends on size, quantity and quality of seed to be handled, the financial status of the individual, time at his disposal to raise seedlings as well as the type of dormancy, [2]. *Myrianthus arboreus* which is an important vegetable species of Southern Nigeria requires domestication and encouragement of its planting by private individuals. Its seed is however known to exhibit dormancy and it is the hope of this study to investigate how this dormancy would be broken and healthy, robust seedlings raised easily and quickly. [3] indicated that its seed germination rate is about 40% and takes about one month to germinate if unaltered. More silvicultural knowledge is required concerning this important wild vegetable since knowledge of species can broaden choices and management options.

A. Taxonomic Description of Myrianthus arboreus (P. Beauv)

Family: Urticaceae.

Common name: Giant yellow mulberry.

Habitat: Rainforest, semi-deciduous forest and swamp forest.

Origin: Indigenous.

Myrianthus arboreus is a medium sized tree with short bole growing up to 20 m in height and 1 m in girth, often divided near the base consisting of many branches with silt-roots. The roots forming a network structure above the ground. The bark is fairly smooth, greyish, thin, slash white.

The leaves are compound enormous and can be up to 50 cm long and 25 cm wide, arranged spirally, palmately compound of 7-9 leaflet which could be sessile or stalked lanceolate or oblanceolate (Plate 1a) with serrated or dentate margin. Stipules are up to 5 cm, caduceous, living annular scars, petiole are 25-55 cm long. Male inflorescence repeatedly branched up to 30cm in diameter, consisting of glomerules with peduncles up to 20 cm long. Female inflorescence is a globolus head up to 6cm long. Flowers are sessile [4].

Flowering and fruiting starts early in life (within 10 years). Fruit is a berry hard and green when unripe but turns yellow and soft when it matures (Plate 1b). Each fruit has about 5 to 15 seeds each surrounded by a sweet acidulous pulp which is commonly eaten. The seeds (Plate 1c) are enclosed in a woody pericarp amounting to 60-65% in weight of the whole seed. The kernel is about 1cm long by 5 to 7 mm across. The seeds of *Myrianthus arboreus* are dispersed by animals such as monkeys and birds. Natural regeneration also takes place around the base of trees in

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forests as well as farmland. In West Africa, the trees flower from January to April and bear fruits from February to July, whereas in Central Africa they can be found flowering throughout the year and in Tanzania, they flower from November [5]. In Nigeria, its fruits are available from May to August.

Plate 1a: *Myrianthus arboreus* leaf.

Plate 1b: Ripe fruits of *Myrianthus arboreus*.

Plate 1c: Seeds of *Myrianthus arboreus*.

II. MATERIALS AND METHODS

A. Study Area

The study was carried out in the nursery of the Department of Forest Resources and Wildlife Management, Faculty of Agriculture, University of Benin, Benin City, Nigeria. It has a GPS location of Longitude 6° 24'E and Latitude 5° 37'N and an altitude of 134m above sea level. The University of Benin is within the moist rain forest zone of Southern Nigeria.

Its mean annual temperature ranges between 27 °C and 32 °C for most of the year. The mean relative humidity ranges from about 75% at noon to over 95% at dawn and mean annual rainfall varies between 1500-2000 mm [6]. The

study was undertaken in two phases: germination and growth phases.

B. Germination Phase

The fruits of *Myrianthus arboreus* were harvested from a phenotypically selected mother tree at Okomu National Park, Arankhuan base camp, Udo, Edo state, Nigeria. Harvesting was done on the 28th of July, 2019. The seeds were depulped on the 29th of July, 2019 in the nursery. They were washed in clean water, rinsed and air dried for 2days, subjected to pre-treatments and sown. A total of 200 seeds were used for the germination phase. The germination experiment was carried out under two light regimes namely: Open light regime and medium light regime. Four seed pretreatment methods were administered under each light regime.

The treatments were:

- 24 hours soaking in water (T1).
- 12 hours soaking in water (T2).
- Stored in a black nylon bag (T3).
- Control (T4) - no treatment.

Twenty-five (25) seeds were sown per treatment making a total of 100 seeds per light regime. Therefore, a total of 200 seeds were used. Medium-sized polythene pots were filled with garden top soil and stacked. One seed each was sown per polythene pot and daily observations were made for germination of the sown seeds until there was no more emergence. A seed was said to have germinated when the plumule raised above the soil level. This phase lasted for 8weeks. Watering, weeding and routine maintenance was done as and when due. Germination parameters investigated were:

- Date of emergence.
- Number of emergent.
- Peak germination: This is the accumulated number of seeds germinated at the point on the germination curve at which the rate of germination starts to decrease.
- Germination percentage: This is an estimate of the viability of a population of seeds. It is obtained by the formula:

$$GP = \frac{\text{Number of seed germinated}}{\text{Total number of seeds sown}} \times 100 \quad [2]$$

Growth Phase: This phase commenced 3 (three) weeks after the end of the germination phase. Observations in the growth phase lasted 8 (eight) weeks.

Five (5) seedlings were randomly selected from each treatment and subjected to weekly monitoring of growth, observations and recordings. A total of 20 seedlings were measured for growth under each light regime. The growth parameters measured include:

1. Seedling height (cm): This is the distance between the seedling collar or the soil level to the tip of the apical bud. This was done using a meter rule.
 2. Number of leaves: This is the visual counting of the leaves of each sample seedling in each treatment under both regime.
 3. Collar diameter (mm): This was measured using a digital vernier caliper round seedling collar.
- At the termination of study, (20 weeks in all) the following parameters were measured:

1. Shoot-root ratio: This was done by measuring shoot and root of each seedlings. (15) seedlings were selected under each light regimes). The ratio of the shoot to root of each seedling was obtained by dividing the mass of the shoot by the root length [7].

2. Wet biomass (gm): This was done by carefully uprooting 15 selected seedlings from each light regime. Each whole seedling was weighed and measured using an electronic weighing balance graduated in grams.

3. Dry biomass (gm): The selected seedlings were subjected to oven drying at a temperature of 130 °C for 2hours [8]. There after the weight of each seedling was taken and summed up for the 15 investigated seedlings.

4. Seedling Moisture content (%): This was obtained by using the formula:

$$MC (\%) = \frac{\text{Wet weight} - \text{dry weight}}{\text{Wet weight}} \times 100 \quad [8]$$

where MC = Moisture content.

C. Light Intensity

The illumination (Photosynthetically Active Radiation) levels were measured three times a week and three times in the observation day at 7am, 1.00pm and 6pm, using a lux meter. Results were pooled and their means relativized using percentages.

D. Experimental Design and Statistical Analysis

The experiment was laid out in a Complete Randomized Design (CRD) pattern. There were four seed pre-treatment methods and two light regimes. Data collected were subjected to graphs, frequency tables (descriptive statistics) and differential statistics (ANOVA). Duncan's multiple range test was used to separate the means where they were significantly different at 5% level of significance.

III. RESULTS

A. Germination

Seed germination type for *Myrianthus arboreus* was hypogeal and it commenced in both light regimes as follows:

Under open light regime, germination commenced on the 15th day for T1 T2 and T4, then 14th day for T3.

Under medium light regime, germination commenced on the 14th day for T1, 15th day for T2, T3 did not germinate and 16th day for T4.

Peak germination was attained under both light regimes as follows:

Under the open light regime, peak germination was attained in the 3rd week for T1, T3 and T4 while T2 recorded two peak germinations which were in the 3rd week and 4th week.

Under the medium light regime- peak germination was attained in the 3rd week for T1, T2 and T4. T3 did not germinate. Overall, germination period for *M. arboreus* was 5 weeks. (Fig. 1).

The germination percentages in both light regimes were as follows:

Under open light regime, the germination percentages were 52, 56, 52 and 56% for T1, T2, T3 and T4 respectively. The germination parameter values are represented on Table 1.

Under the medium light regime, the germination percentages were 100, 64, 0 and 32% for T1, T2, T3 and T4 respectively.

Under the medium light regime T3 exhibited some degree of fungal infection, as whitish mycelia of fungus covered the seeds. These infested seeds had radicles emerging but when transferred to polypots, did not become seedlings. The embryonic shoot (plumule) failed to emerge.

Fig 1. Germination trend of *Myrianthus arboreus* seeds in relation to treatment.

TABLE I: GERMINATION PARAMETERS UNDER DIFFERENT SEED PRE-TREATMENT METHODS AND BOTH LIGHT REGIMES

Location	Pre-treatment	DE	NE	GP	G%	X
Open light regime	24 hours soaking in water (T1)	15	13	3 rd week	52%	4.33 ^a
	12 hours soaking in water (T2)	15	14	4 th week	56%	4.67 ^a
	Tied in black nylon (T3)	14	13	3 rd week	52%	4.33 ^a
	Control (T4)	15	14	3 rd week	56%	4.67 ^a
LSD= 1.78						
Medium light regime	24 hours soaking in water (T1)	15	25	3 rd week	100%	8.33 ^a
	12 hours soaking in water (T2)	14	16	3 rd week	64%	5.33 ^a
	Tied in black nylon (T3)	13 (radicle only)	10 (radicle only)	-	0	0 ^c
	Control (T4)	15	9	3 rd week	32%	3.00 ^b
LSD=3.24						

Key: DE: Days to Emergence, NE: Number of Emergence, GP: Germination Peak, G%: Germination Percentage.

*Mean values with the same subscript under each regime are not significantly different.

Light intensity (PAR): The mean PAR values for the period of observation ranged between 250 – 456 and 157 – 227 μ for the open and medium light regimes respectively (Table II).

TABLE II: MEAN DAILY LIGHT INTENSITY UNDER INVESTIGATED LIGHT REGIMES

Weeks	REGIMES	
	Open light regime Relativized %	Medium regime Relativized %
2 nd week	100	40
6 th week	54.8	34.4
10 th week	66.8	50

B. Growth parameters

1. Seedlings height (cm)

At the termination of growth study (20 weeks after sowing) mean height was 10.22 cm and 5.36 for open light regime and medium light regime respectively. There was significant difference in height under the two different light regimes. Growth rate per week was approximately 0.28cm and 0.15 cm under open light regime and medium light regime respectively. Typical seedling under two light regimes are shown on Plate 2a and 2b. Values of growth parameters are indicated on Table III.

Plate 2a: A typical seedling under the open light regime.

Plate 2b: A typical seedling under the medium light regime.

2. Collar girth (mm)

The mean collar girth was 1.99 and 1.11 in the open light regime and medium light regime respectively. Average collar girth per week were 0.09 and 0.06 in the open light regime and medium light regime respectively. This result showed that collar girth under different light regimes was significantly different.

3. Number of leaves

The true leaves emerged 3 weeks after germination. Germinating seedlings were initially simple leaf arrangement but changed to compound leaf from the 7th week. The mean number of leaves were 3.39 and 2.23 in open light regime

and medium light regime respectively. Average number of leaf per week was 0.15 and 0.09 in the open light regime and medium light regime respectively. There was a significant difference in the number of leaves ($p>0.05$).

4. Shoot to root ratio

The mean shoot to root ratio of the seedlings were 1.01 and 0.99 in the open light regime and medium light regime respectively. There was no significant difference in the shoot to root ratio of seedlings.

5. Wet biomass (gm)

The mean of fresh biomass of seedlings (both shoot and root) were 1.4 and 0.6 in the open light regime and medium light regime respectively. There was a significant difference in the fresh weight of the seedlings.

6. Dry biomass (gm)

The means of dry biomass of seedlings were 0.58 and 0.18 in the open light regime and medium light regime respectively. Seedlings growth values are on Table III.

TABLE III: MEAN VALUES OF GROWTH PARAMETERS IN RELATION TO SEED TREATMENT AND LIGHT REGIMES

Light regime	Height (cm)	Collar girth (mm)	Number of leaves	Shoot/ root ratio	WB	DB	MC %
Open light	10.22 ^a	1.99 ^a	3.39 ^a	1.01 ^a	1.4 ^a	0.58 ^a	57 ^b
Medium light	5.36 ^b	1.11 ^b	2.23 ^b	0.99 ^a	0.63 ^b	0.18 ^b	70 ^a
LSD	0.47	0.16	0.28	0.44	0.24	.09	7.0

Key: WB: Wet biomass, DB: Dry biomass, MC: Moisture Content percentage.

IV. DISCUSSION

The date to commencement of germination was about the same irrespective of treatment and light regime. Fungus discouraged germination in T3 under the medium light regime. Seed treatments gave similar germination percentages under the open light regime but was positively higher under the medium light regime with seeds soaked in water for 24 (hours) (T1). This indicates that *Myrianthus arboreus* has better germination under the medium light regime. As germination percentage was higher in T1 under the medium light regime, this agrees with [9] that in some types of seeds, pre-treatment is important in artificial regeneration in order to obtain a reasonably high germination rate in a short time. Soaking for 24 hours was able to soften the seed coat and quicken imbibition and subsequent germination. Open light situation on the other hand encouraged drying of the seed and reduction in enzymatic activities.

The least germination percentage was recorded in T3 under the medium light regime. This implies that stored seed in non-opaque polythene bag could reduce viability and germination potential of the seeds by increasing their susceptibility to fungal attack. This proves that *Myrianthus arboreus* seeds are recalcitrant and would be better sown without storing and delay after processing since the seed are albuminous and moisture laden.

Seedlings under the open light regime did better in collar diameter, number of leaves, wet and dry biomass, shoot to root ratio, this shows that higher light intensity enhances the growth of this species. This agrees with the work of Montgomery and [9] who reported that the best growing seedlings of *Dipteryx panamensis*, *Basimum alicastrum* in

terms of collar diameter and number of leaves was better under high light intensity. It is however contrary to the work of [10] who observed that the relative growth rate of Cocoa was highest under moderate shade with irradiance levels of 25% to 50%. This therefore indicates that species have different physiological reactions to light.

The seedlings under the medium light recorded a higher moisture content % compared to the seedlings under the open light regime. This indicated that the rate at which water was lost by the seedlings through transpiration is lower under the medium light regime compared to the seedlings under the open light regime. This advantage in water economy did not however translate into bigger seedlings under the medium light regime probably because the light regime was a not enough for the seedlings to achieve their best photosynthetic potential plus the fact that seedlings under medium light regime had fewer leaves which are the structure that absorb light radiation which push photosynthesis and subsequent growth.

That *Myrianthus arboreus* seedlings did better under the medium light regime in terms of germination indicates that some shading is require for optimum germination of its seeds. However, in order for a suitable growth to be attained by this species, it seems lighter. Under natural forest situation, there would be need for canopy opening to release germinated seedlings for growth.

V. CONCLUSION

Myrianthus arboreus exhibited hypogeal germination. Germination percentage was highest in T1 – (24 hours soaking in water) which gave 100% germination under medium light regime, the control gave 56% and 32% in the open light regime and in the medium light regime respectively.

Open light regime enhanced its growth in terms of collar diameter, height, number of leaves and dry biomass but not wet biomass. With the fact that T1 under medium light regime did better in germination percentage, it means that seed pre-treatment methods are needed in its silvicultural operation.

The seedlings do not do well when tied in the a non-opaque polythene bag as evident in T3 under medium light regime as it recorded radicle extension but the infestation of fungus prevented embryonic plumule to emergence. This is an indication of recalcitrant characteristic of the seed and poor storage status.

Based on the findings it is recommended the seeds be sown under medium light regime after soaking for 24hours thereafter transferred to open light condition (shade removed) at the 2-leaf stage in order to have good growth and robust seedlings.

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