



**PRE-GERMINATION AND DORMANCY RESPONSE OF *MORINGA OLEIFERA* (DRUM STICK) SEEDS TO PRE-TREATMENTS TECHNIQUES AND GROWTH MEDIA**

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**Abstract:**

The study investigated the effects of two pretreatment techniques (Cold water and Hot water) and growth media on breaking seed dormancy and germination response of *Moringa oleifera* seeds. The seeds were immersed in cold water (3hrs, 6hrs, and 12hrs) and hot water (7min, 10min, and 14min). After pre-treatment the seeds were sown on three different growth media. Randomized complete Block design with 2 treatments and 3 germination media was adopted for this experiment. The result showed that earliest mean days of emergence (8days) was observed in seeds subjected to cold water treatment soak for 12hrs time interval and sowed in sandy soil as growth medium. The highest rate of germination was recorded in cold water treatment soak for 12hrs and sowed in sandy soil growth medium (13) and loamy soil growth medium (10) with significant variation while the other recorded the lower germination rate (01-04). Sandy soil growth medium showed significant effect in cold water treatment soak for 12hrs. Thus cold water soaked for 12hrs and sowed in sandy soil growth medium was recommended for pretreatment of *Moringa oleifera* seeds prior to planting to improve germination performance. In situations where the use of cold water pretreatment might be limited by certain risk factors, control should be adopted.

**Keywords:** Germination, Dormancy, Pre-treatment, Growth Media, and *Moringa oleifera*

**INTRODUCTION**

*Moringa oleifera*, also known as Drumstick tree, Moringa or miracle tree is a fast-growing drought-resistant, a multipurpose tropical tree of the family Moringaceae native to tropical and subtropical regions of South Asia. It is mainly used for food and has numerous industrial, medicinal and agricultural uses, including animal feeding. Trees of Northern Nigeria, specifically, the semi-arid regions of the country were of a great use especially to rural or peasant farmers whose life solely depends on agricultural productions, this is because most of the rural economy in the region is agricultural, and This is a fast-growing, deciduous tree with height ranging from 10 to 12m (32-40ft) when mature and trunk diameter from 45cm (1.5ft). The bark has a whitish-gray color and is surrounded by thick cork. The tree has an open crown of drooping, fragile branches and the leaves build up a feathery foliage of tripinnate leaves (Singh *et al*, 2012).

*Moringa oleifera* tree is highly valued plant that is mostly cultivated or grown mainly in semi-arid, tropical and subtropical areas, corresponding in the United States to USDA hardiness zone 9 and 10. It tolerates a wide range of soil condition but prefers a neutral to slightly acidic (pH 6.3 to 7.0), well-drained sandy or loamy soil. In water logged soil, the roots have a tendency to rot. Also, in most developing countries, Moringa has the potential to improve nutrition, boost food security, foster rural development and support sustainable land care. It may be used as forage for livestock, a micro nutrient liquid, a natural anthelmintic and possible adjuvant (Anjorin *et al.*, 2010).

It has been reported by Bureau of plant industry that Moringa is an outstanding source nutritional components. Its leaves (weight per weight) have the calcium equivalent of four times that of milk, the vitamin C content is seven times that of oranges, while its potassium is three times that of bananas, three times the iron of spinach, four times the amount of vitamin A in carrots, and two times the protein in milk (Fuglie, 2001). Besides, Moringa is also suggested as a viable supplement of dietary minerals. The pods and leaves of Moringa contains high amount of Ca, Mg, K, Mn, P, Zn, Na, Cu, and Fe (Aslam *et al.*, 2005). Although, minerals content of Moringa shows variation in composition with changes in location (Anjorin *et al.*, 2010).

Ancient medicinal system relies on several plant products used by traditionally human communities in many parts of the world for different diseases. Among these plants, *Moringa oleifera* has its great contribution from ancient time. It is a plant with exceptional medicinal properties which can resolves the health care needs in several situations. Easy cultivation of Moringa within adverse environmental condition and wide availability attract attention for economic and health related potential in resource limited developing countries.

Seed germination is one of the most important stages in life cycles of plants. Germination is affected by all of the environmental factors affecting vegetative growth. Germination requires favourable temperature, oxygen, water and lack of inhibitory substances in the environment. Seeds of many plant species cannot germinate despite favourable environmental conditions required for germination. Main reasons for this problem, which is termed as seed dormancy, are hard and impermeable seed coat and presence of immature or dormant embryo (Olmez *et al.*, 2008). Many seeds have difficulty in germination such that their propagation is adversely affected by seed coat dormancy leading to poor growth potential (Okumo, 2010). Dormancy is an adaptation that ensures seeds will germinate only when environmental conditions are favorable for survival. The conditions necessary to allow seeds to “break” dormancy and germinate can be highly variable among species, within a species, or among seed sources of the same species (Hermansen, *et al.* 2000). Seeds that have hard, thick seed coats that physically prevent water or oxygen movement into seeds have physical dormancy (Amusa, 2011).

This research is only limited to determine the effects of two pre-treatment techniques (Cold water and Hot water) on breaking seed dormancy and three growth media (River sand, Loamy soil and Saw dust) was used to investigate seedling growth effect on *Moringa oleifera* (drumstick).

## Materials and Methods

### *The Study Site*

The experiment was carried out in collage of Agriculture, Hassan Usman Katsina Polytechnic which is located at Batagarawa L.G.A. , Kastina state Nigeria (the extreme margin of Northern Nigeria) that lies on geographic coordinates of 11°08'N and 13°22'N and longitudes 6°52'E and 9°20'E. It falls within the Sudan Savannah vegetation belt and its climate is Tropical continental type that is hot and dry for most of the year. Maximum day temperature of about 38°C in the months of March, April, and May are common and the minimum temperature is about 22°C in the month of December and January. The mean annual rainfall is about 780mm (Rumah and Sheikh, 2010).

## Experimental Procedure and Design

### *Seed Collection*

The seeds used in this research work was sourced at EEC (European Economic Community) Kastina state and viability test was carried out for the seed through flotation method.

### **Experiment 1 (Cold Water Treatment)**

This trail was conducted to assess the effects of different soaking times in cold water on the seeds of *Moringa oleifera*. 180 seeds were respectively soaked in distilled water at ambient temperature (28°C) at three different times (3hrs, 6hrs, and 12hrs)

**Experiment 2 (Hot Water Treatment)**

This trial was conducted to assess the effects of different boiling times in hot water on the seeds of *Moringa oleifera*. Water was allowed to boil for 15mins. Thereafter, 180 seeds were respectively added to the boiled water and allowed to boil for three different times (3mins, 5mins and 7mins). After boiling for the specified times, the seeds were removed and allowed to cool down.

**Control Treatment**

This trial was conducted to have a comparable effect of no pre-treatments of *Moringa oleifera* seeds in the three growth media.

**Growth Media**

The growing media were loamy soil, river sand and sawdust. The river sand were sieved using 2mm sieve to remove stones, roots and other materials that may hinder the emergence of the plumule upon seed germination. All unwanted materials that may hinder seed germination were also removed from the sawdust and loamy soils. After the pretreatments were carried out and the seeds air-dried after 24hrs, the seeds were then planted in the germination boxes and replicated per treatment, per growing media, and per time.

**Experimental Design**

The experiment was a 2 x 3 x 3 factorial experiment involving two treatments (Cold water and hot water), three growing media (loamy soil, river sand and sawdust), and two time intervals (3mins, 5mins and 7mins – hot water treatment); and (3hrs, 6hrs, and 12hrs – cold water treatment)) which were all replicated three times. The parameters assessed in the course of the experiment include: Days of Emergence (Numbers of days taken for first emergence); Rate of Germination (Numbers of seeds germinated); and Germination percentage.

**Statistical Analysis**

The cumulative data collected were computed and subjected to Analysis of Variance (ANOVA) by adopting the Randomized Completely Block Design (RCBD). Mean Separation was carried out for significantly different parameters by using the Duncan's Multiple Range Test (DMRT), to determine the more suitable pre-treatment technique and growing media for the germination potential of the seeds of 113 *Moringa oleifera*.

**Results and Discussion****Results**Table 1: Mean Days of Emergence of *Moringa oleifera* (28 days after planting (DAP)).

Growth Media	Cold Water Treatment			Hot Water Treatment			Control
	3Hrs	6Hrs	12Hrs	7Mins	10Mins	14Mins	
Loamy Soil	14	11	11	10	0	0	16
Sandy Soil	10	11	08	10	11	10	10
Sawdust	09	11	17	13	0	0	22

DAP=Days After Planting.

Table 2. Germinated Seeds of *Moringa oleifera* (28 DAP)

Growth Media	Cold Water Treatment				Hot Water Treatment				Control
	3Hrs	6Hrs	12Hrs	T.S.G	7Mins	10Mins	14Mins	T.S.G	
Loamy Soil	05	07	10	22	02	0	0	02	09
Sandy Soil	07	10	13	30	04	03	01	08	15
Sawdust	04	06	05	15	03	0	0	03	06
T.S. G	16	23	28	67	09	03	01	13	30

**T.S.G - Total Seeds Germinated**

**Table 3. Effects of Pre-treatments on Germination of Seeds of *Moringa oleifera***

Cold Water Treatment		Hot Water Treatment	
Time (Hrs)	Mean G.S	Time (Mins)	Mean G.S
3	<b>5.331<sup>abc</sup></b>	7	<b>3.00<sup>bc</sup></b>
6	<b>7.66<sup>a</sup></b>	10	<b>1.00<sup>bc</sup></b>
12	<b>9.33<sup>abc</sup></b>	14	<b>0.33<sup>bc</sup></b>

Means followed by same alphabet are not significantly different ( $P>0.05$ ) i.e at 5% level of probability (DMRT). G.S - Germinated seeds.

**Table.4 Effect of Growth Media on Germination of Seeds of *Moringa oleifera*.**

Growth Media	Cold Water Treatment	Hot Water Treatment	Control
Loamy Soil	<b>7.33<sup>abc</sup></b>	<b>0.66<sup>b</sup></b>	<b>4.5<sup>bc</sup></b>
Sandy	<b>10.00<sup>ab</sup></b>	<b>2.66<sup>bc</sup></b>	<b>7.5<sup>abc</sup></b>
Sawdust	<b>5.00<sup>bc</sup></b>	<b>1.00<sup>b</sup></b>	<b>3.00<sup>abc</sup></b>

Means followed by same alphabet are not significantly different ( $P>0.05$ ) at 5% Probability level (DMRT).

**ANOVA Table for Experimental Data in Table 3.**

Source of Variation	DF	SS	MS	F Cal.	F Tab.
Blocks	2	20.49	10.25		
Treatments	1	53.93	26.97	<b>5.64<sup>ns</sup></b>	<b>7.71<sup>ns</sup></b>
Error	4	-9.57	-4.78		
Total	7				

Ns- Not significant'

Source of Variation	DF	SS	MS	F Cal.	F Tab.
Blocks	2	21.73	10.87		
Treatments	1	54.63	27.34	<b>15.23<sup>≥</sup></b>	<b>5.59<sup>≥</sup></b>
Error	4	3.59	1.795		
Total	7				

≥ - Significantly different.

## Discussion

### *Pre-treatment Techniques*

The findings revealed that cold water pre-treatment reduce the period of dormancy as seeds pretreated with cold water for 12hours emerged earlier (8<sup>th</sup> day after sowing averagely) those seeds pretreated with hot water. It is also shows that cold water pretreatment gave the very high total seeds germination and higher rate of germination which was significantly different at 12hour soaking period (Tables 2 and 3). Thus Seeds soaked in cold water also reduces dormancy period and giving a considerable germination percentage (Table 2 and fig 3) contrary to the report of Danthu, *et al*, (1995), who acclaimed that soaking in cold water was generally ineffective. Earlier studies (Ibrahim and Otegbeye (2004), Agboola and Adebire, 1998; and Aduradola and Shinkafi, 1999 cited in Emerhi and Nwuisuator, 2010) have shown that soaking in water is a feature that enhances germination in seeds of tropical trees.

The insignificantly low percentage germination of hot water treatment gave a contrary result as against that which would have been naturally expected when compared with the control which yielded a fair germination percentage (Table 2 and 4). The implication of this is that hot water pretreatment is not a suitable technique in seeds of *Adansonia digitata* as well as *Azizelia africana* as stated by Amusa, (2011). He opined that, subjecting the seeds to hot water could lead to the seed embryo been killed because of prolonged contact with boiled water. This is contrary to the view of Saikou, *et al.*, (2008), who offered that pre-treatment of *Acacia Senegal* seeds in hot water for 10min, increased its growth potential.

### **Growth Media**

The findings revealed that sandy soil growth medium showed the lowest days of emergence, but highest rate of seeds germination (Table 2) for 12hour soaking period and highest germination mean average (Table 4). The treatments showed significant effect on seeds germination in sandy soil growth medium for seeds soaked for 12 hour and the control likewise showed a significant effect in sandy soil medium with best rate of germination. While hot water pretreatment also showed a significant effect in sandy soil growth medium but with a lower percentage germination.

The findings affirmed with the investigation of Chia, *et al.*, (2008), who revealed that, the highest percentage germination was recorded in sandy soil (75%), followed by humus soil (32.7%). However, the highest number of days before emergence was recorded in humus soil. In general sandy soil supported germination of seeds than the other soil media which can be related to early emergence (Table 1), high rate of germination (fig. 2 and 4).

According to Chia, *et al.*, (2008), when seeds are subjected to excess water as in the case of soils or growth medium with high water retention capacity, it is prone to decay, therefore not likely to germinate and establish itself. This could explain why sawdust had the lowest germination performance as a result of its high water retention and also. In the other hand the study showed a little difference of germination performance between sandy soil at 12hr soaking interval and control.

### **Conclusion and Recommendation**

This study investigated the effect of two pre-treatment techniques and three growing media on breaking seed dormancy and germination response of seeds of *Moringa oleifera*. It was revealed that cold water treatment gave the least mean days of seeds emergence at 12hr soaking time in sandy soil. The rate of germination recorded the highest number of seeds in sandy soil followed by loamy soil and then in sawdust. Sandy soil had better germination performance compared with the two other growth media. This was confirmed by the significant effect exhibited in sandy soil growth medium at cold water treatment for seeds soaked for 12h, while a fair result was showed in the control, while sawdust growth medium gave the lowest germination performance.

Based on the findings of the research work, it is therefore recommended that to improve the period of breaking seed dormancy and enhance germination of *Moringa oleifera* seeds, Cold water pretreatment at 12 hour soaking period and sandy soil growth medium should be adopted rather than hot water. In situations where the use of cold water pretreatment might be limited by certain risk factors, control should be adopted.

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