



Effect of pre-sowing treatment techniques on seed germination and early growth performance of *Adansonia digitata* (L.) seedlings

Abebe Shume^{1*}, Mubarek Eshetie^{*4}, Yonas Belete², Girma Niguse¹, Birhan Wore¹, Menale Wondie³, Beyene Belay³, Getu Abebe⁴, Yekoye Alene¹, Amaru Semhagn¹ and Sleshi Asmare¹

^{1*}Sekota Dry Land Agricultural Research Center, P.Box, 62 Sekota, Ethiopia

²Debretabor University, Department of Forestry Debretabor, Ethiopia

³Amhara Agricultural Research Institute, Forestry Research Directorate, Bahir Dar, Ethiopia

^{4*}Gondar Agricultural Research Center, Forestry Research Directorate, Gondar, Ethiopia

Corresponding author email: eshete99@gmail.com

Copyright: ©2024 The author(s). This article is published by BNJAR and is licensed under the CC BY 4.0 license (<http://creativecommons.org/licenses/by/4.0/>).

ABSTRACT

Received: August 15, 2022

Revised: November 24, 2022

Accepted: December 15, 2022

Available online: December 28, 2022

Keywords: Baobab, Nursery, Pre-sowing treatment, Seed, Seedlings

Adansonia digitata (L.) (Baobab) seeds have very hard seed coats and the natural germination rate is less than 20%. Hence, the general objective of the study is to evaluate the germination capacity of baobab seeds under different pre-sowing treatment techniques. Besides, the study evaluates the early growth performance of baobab seedlings under different irrigation periods in the nursery. The experiment was carried out in in Sakota Dry land Agriculture Research Center laboratory, Ziquala district, Amhara region. The experiment consisted of seven treatments, three physical (hot water soaking for 5-7 minutes plus nicking), cold water soaking for 72 hours plus nicking and nicking only) and four chemical (soaking the seeds in concentrated sulphuric and acid nitric acid for 1 and 6 hours) pre-sowing treatments in the laboratory. However, early observations prevail that germination was possible only in the three physical treatments. Therefore, it was a very important and pressing issue to work on pre-sowing treatments focusing on physical treatments. Based on this, six physical pre-sowing techniques have been formulated and implemented. Subsequently, the frequency of watering experiment was replicated four times using a randomized complete block design in the nursery. Seed pre-sowing techniques have significant differences in early germination dates at the nursery. Scarifying seeds and soaking in cold water for 12 hours (T1) recorded the least germination time and the highest germination percentage (60.7%). Watering frequency had a significant effect on growth parameters of baobab seedlings ($P < 0.05$). The results of pre-sowing treatment techniques indicate that without proper pre-sowing treatment, baobab seeds cannot germinate effectively. Furthermore, daily watering improves the growth parameters of baobab seedlings more than other watering frequencies. Treatment 01 (T1) shortens the germination period and improves the germination rate. This treatment rapidly softens the impervious membrane, promote water entry and gas exchange through the embryo and thus stimulating the embryo to emerge. In addition, daily watering helps improve the growth of the Baobab seedling and produce a vigorous seedling. Therefore, scarifying seeds and soaking them in cold water for 12 hours enhances germination of the Baobab seeds. In addition, watering about 200 ml of water per seedling per day enhances early growth performance and biomass production at the nursery site.

1. INTRODUCTION

Adansonia digitata L. (Baobab) is a large iconic tree indigenous to Africa where it is found in many countries (Kamatou et al 2011). It is commonly called a Baobab and has many common names like a dead-rat tree, monkey-bread tree, and up-side-down tree (Rama et al 2017). The Baobab tree belongs to a pan-tropical family and is widely spread all over the hot, drier regions of tropical Africa and is prevalent south of the Sahara and is commonly considered as an African symbolic tree (Gebauer et al 2002; Komane et al 2017). In Ethiopia, it grows in the Bereha and Dry Kolla agro climatic zones of Tigray, Waghemira, and Gondar (common in Tekeze Valley) (Azene and Tegnäs 2007). Baobab trees are found widely dispersal in Waghimira Zone; Abergele and Ziquala woreda.

Baobab is an important multi-purpose fruit tree with a high potential for domestication in drier Africa (Bilcke et al 2013). It is extremely important to humans and animals in the dry areas of Africa because it offers shelter, a source of nutrition, clothing as well as raw material for many useful items (Kamatou et al 2011). Many forest tree species face difficulty in seed germination due to seed dormancy or the presence of hard seed coats leading to poor growth potential (Falemara et al 2014; Chadare 2010). In natural conditions, baobab seedlings do not emerge immediately after seeds are released from ripe fruits due to a physical dormancy imposed by hard seed coats which appear to be non-permeable (Sidibe and Williams 2002). Pre-sowing treated seeds are used to enhance the accessibility of water and oxygen into the seeds before planting, to break dormancy, and to obtain optimum germination and improved performance for plantation establishment (Falemara et al 2014).

Baobab species are facing a high risk of extinction because of the low rate of natural regeneration (Gebauer et al 2002). Knowledge of seed germination dynamics is an important tool to increase reproduction success (Macoumba et al 2015). But even in such optimal conditions, Baobab seeds often remain for several weeks in the soil before germinating

(Gebauer et al 2002; Macoumba et al 2015). Mostly, baobab is germinated by seed; seeds can be collected from picked or fallen fruit (Gebauer et al 2002). After crushing the hard woody shell of the fruit, the seeds can be extracted from the dry acidic pulp. Baobab seeds have very hard seed coats and germination is usually less than 20% (Danthu et al 1995). Baobab is a multipurpose tree species that is used for human beings and animals. However, it had diminished its extent from time to time due to poor performance of natural seed germination potential, extra exploitation for humane food and animal forage, and agricultural expansion and settlements. No nursery site raises Baobab seedlings in the study areas. Because, the agricultural and forestry experts, nursery supervisors, and local communities could not germinate the seed simply like other tree seeds.

Therefore, appropriate pre-sowing treatment, growth media and watering frequency may improve to facilitate the germination of Baobab seeds. Therefore, the overall aim of the study is to evaluate the germination potential of *A. digitata* seeds in different pre-sowing treatment techniques and evaluate the early growth performance of *Adansonia digitata* seedlings under different watering frequencies in the nursery.

2. MATERIALS AND METHODS

2.1. Study area

The experiment was carried out at Sekota dry land agricultural research center at room temperature. At the nursery, the study was conducted in the Ziquwal district, Amhara regional state of Ethiopia. The study area is geographically located between 12°23' to 13°16'N longitude and 38°44' to 39°21' E latitude, with altitudinal rang of 1340 to 2200 above sea level (Figure 1). The mean minimum and maximum annual rainfall of the study area are 642 and 987 mm, respectively. The rainfall pattern of the area is short rain season with the small rain occurring mainly July to August. This pattern, however, is extremely variable with some times of no rainfall during the short rainfall season. The average temperature ranges between 21°C to 25°C. The experiment was done in November–May 2020.

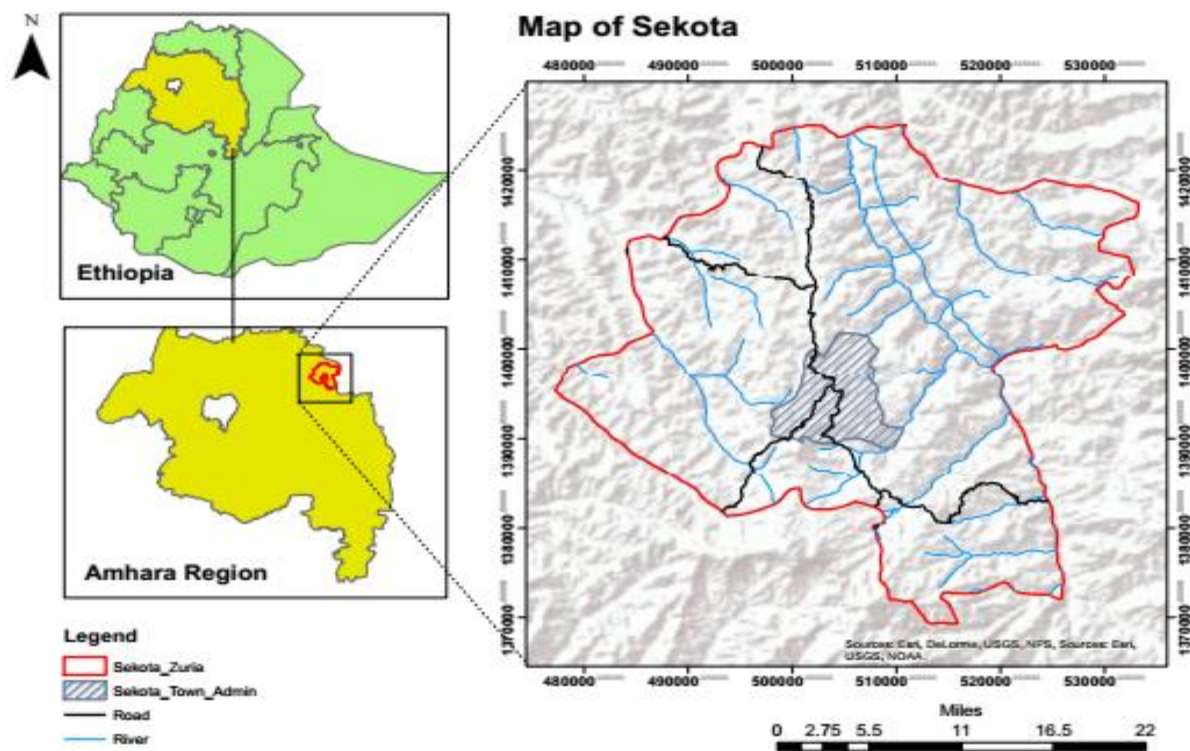


Figure 1: Map of the study area

2.2. Seed Collection and Processing

Mother tree selection and seed collection

Baobab trees are growing in semi-arid and arid dryland parts of the Sahel region of Africa, particularly in East Africa such as Eritrea, Sudan, and Ethiopia. In Ethiopia, it is common in Western Gondar, Waghimra (Abergelle and Ziquala) growing mostly in remote and inaccessible areas. However, baobab seeds and leaves have been over-exploited for local consumption, including fodder, food, and shelter. In general, baobab trees have numerous benefits and functions for dryland areas (arid and semi-arid areas). Mother tree selection has been done. Two districts were selected for baobab mother tree selection; Abergelle and Ziquala (Village). The dry pods were harvested from mother trees in December 2019. The collected pods were broken and the seeds were extracted, washed with cold water, and air-dried for 3 days. A viability test was carried out for the seeds using the floatation method (Oboho *et al* 2017).

2.3. Experimental Design and Treatments

Pre-sowing at laboratory

The room light was on all over the experiment

time to give heat to the seed that help to initiate germination. Pods were harvested from mother trees from the lowlands of Abergelle and Ziquala districts where the natural stands were found. Then more fruit or pods were broken, seeds were rinsed in water and the powder covering the seed was washed away and the seeds were air dried. The experimental design was completely random design having seven treatments and replicated four times (hot water (5-7 minutes) plus scarification (nicking), cold water (72 hours) plus nicking, nicking only, soaking the seeds in concentrated sulphuric acid for 1 and 6 hours, and soaking the seeds in concentrated nitric acid for 1 and 6 hours). Twenty-five (25) seeds were placed in each Petri dish and regularly watered for 40 days

2.4. Pre-sowing treatments at the nursery Level

The laboratory experiment was carried out through hot water (5-7 minutes) plus scarification (nicking), cold water (72 hours) plus nicking, nicking only, soaking the seeds in concentrated sulfuric acid for 1 and 6 hours and soaking the seeds in concentrated nitric acid for 1 and 6 hours. Physical treatments have germinated only on Petr-dish, could not

emerge viable shoot as perform as quality seedling. Therefore, the pre-sowing treatments were requested modifications that focused on physical pre-sowing treatments. Physical pre-sowing treatments provided a remarkable response at the laboratory level. Accordingly, six pre-sowing techniques were modified namely:

- T1- Scarifying seeds and soaking in cold water for 12 hours
- T2- Scarifying seeds and soaking in hot water for 10 minutes
- T3- Scarifying seeds
- T4- Soaking seeds in cold water for 12 hours
- T5- Soaking seeds in hot water for 10 minutes
- T6- Control (untreated seeds)

The soil mixture with the ratio of 3:2:1 topsoil, compost, and sand soil respectively, was used to raise the seedlings at the Ziquala Nursery site. To protect against the disease pathogen, the soil medium was subjected to sun-ultraviolet for 72 hours with the additional mixing of each other. The experiment was done in a Randomized Complete Block Design (RCBD) with six treatments and three replications. Each treatment had one hundred twenty seeds making 720 seeds in all treatments (One seed per pot).

2.5. Watering Frequency

The watering regime frequency experiment was carried out at the Ziquala nursery site. Three months old baobab seedlings were randomly selected and subjected to four different watering intervals (Once daily, once after 3, 7, and 14 days). Five seedlings were allocated per watering frequency and were replicated four times making 20 seedlings per watering frequency in a Randomized Complete Block Design (RCBD). Each seedling was sprinkled 200ml of water in the morning for three months based on the watering frequency intervals (Mukhtar et al 2016).

2.6. Collected Data

Germination parameters investigated included date of emergence, period of germination, and germination percentage. The growth variables measured were: seedling stem height, collar

diameter, and the number of leaves. The Meter rule was used to measure height, caliper for collar diameter, and the number of leaves was counted fortnightly for twelve weeks. Fresh biomass of root, stem, and leaf was measured by the destructive method at the end of the experiment. The dry biomass was taken after being dried at oven dry at 65° C for 72 hours to become constant weight (Mukhtar et al 2016).

2.7. Statistical Analysis

The data was analyzed using multiple comparison tests using graph pad prism software (v8.0.1) and excel software. Total germinated seed percentage, and mean germinated, and diseased seed graphs were plotted to determine the more suitable pre-treatment technique for the germination potential of the seeds of *Baobab*. Data collected were subjected to descriptive statistics and analysis of variance (ANOVA). The means of the significantly different parameters were separated using Duncan Multiple Range Test at the significance level of 0.05.

3. RESULTS AND DISCUSIONS

3.1. The Germination Status of the Baobab Seeds at the Laboratory Level

The experiment was undertaken at room temperature and germination variations of different treatments were recorded. The data was collected on a daily bases after 3 days of sowing *Adansonia digitata* L seeds on Petridis. The number of germinated seeds was higher during the first week's experiment (Figure 2a); all treatments had a high rate of germination during this week. However, the number of diseased seeds increased after the first week of the experiment (Figure 2b). Hot water treatment had slightly better mean germination (82%) compared to the others. There was a higher infection of fungus was observed in cold water and nicking, about 24% of the seeds were infected by fungus. Only three treatments (hot water plus nicking, cold water plus nicking, and nicking only) gave the response. Other treatments (chemicals and control treatments) were kept not germinated even after 40 days of follow-up.

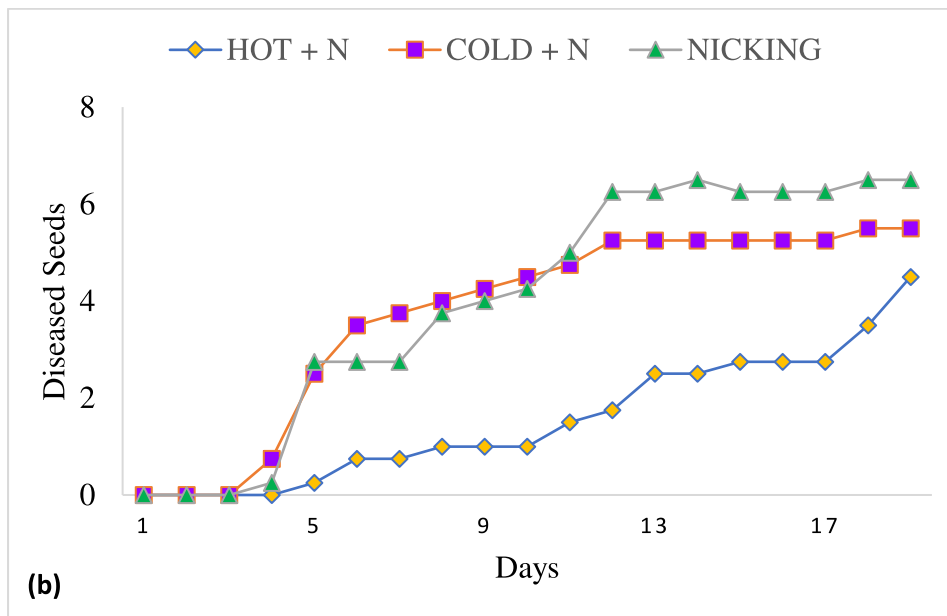
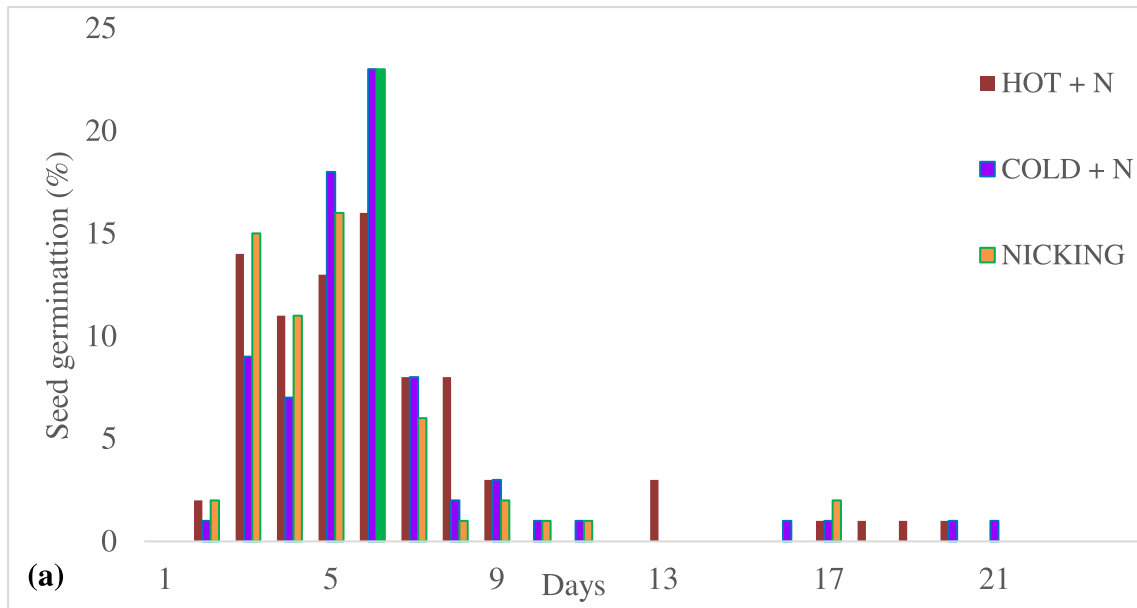


Figure 2: Mean germinated (a) and diseased (b) seed trend data for Baobab seeds after 22 days under different seed pre-sowing treatment methods. *Note: HOT + N mean hot water plus nicking, COLD + N means cold water plus nicking and NICKING means nicking of seeds.*

Hot water plus nicking, cold water plus nicking, and nicking treatment data were used for time-to-event analysis to plot germination rate and variation among treatments (Multiple comparisons test). There was no information on the viability of ungerminated and diseased seeds in our experiment, therefore they were considered non-viable and erased from the data analysis. We plotted a graph for trends of germination percentage using time-to-event analysis (Log-rank (Mantel-Cox) test) (Figure 3). However, there was no significant difference between treatments ($P = 0.154$) under a 95% of the confidence interval (Table 1).

Table 1: Mean germination of *Adansonia digitata* seeds under three treatments

Multiple comparisons test	Mean rank diff.	Significance	Adjusted P Value
HOT + N Vs. COLD + N	12.71	*	0.037
HOT + N Vs. N	1.588	ns	>0.999
COLD + N Vs N	-11.12	ns	0.085

Note: * represent there is a significant difference between treatments and ns means there is no significant difference between treatments ($\alpha < 0.05$).

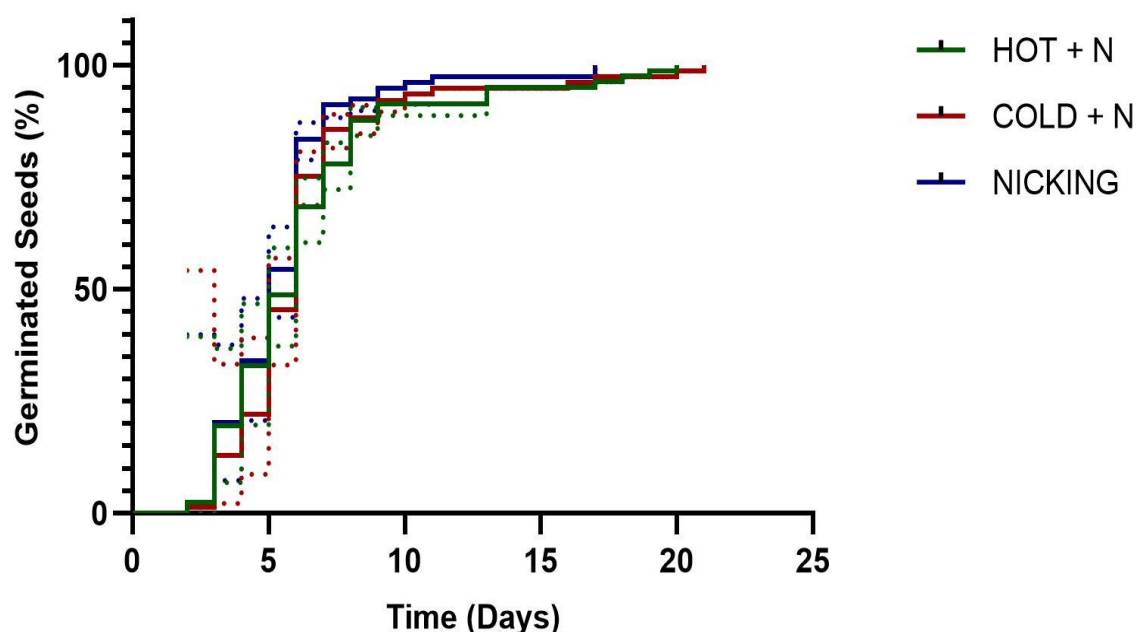


Figure 3: Germination percentages of Baobab seeds after 22 days under different pre-sowing treatment techniques.

3.2. The Germination Status at the Nursery Level

3.2.1. Days to emergence

Germination commenced for T1, T2 and T4 were after sowing 09, 11 and 12 days, respectively. While, control (untreated seeds) were emerged after 37 days of sowing. Seed pre-sowing techniques affected significantly due to days to emergency. However, Scarifying and soaking seeds in cold water for 12 hrs and only soaking seeds in hot water for 10 minutes had not showed statistical differences. Scarifying and soaking seeds in hot water for 10 minutes, and only soaking seeds in cold water for 12hrs had no significant difference ($p < 0.05$) (Table 2).

3.2. Germination period and percentage

The germination period was significantly ($p < 0.05$) affected by different seed pre-sowing techniques (Table 2). The shortest period of seed germination was observed in scarifying

seeds and soaking in cold water for 12 hours (T1) and scarifying, and soaking seeds in hot water for 10 minutes (T2) (12 weeks). The longest period of seed germination was observed in soaking seeds in cold water for 12 hours (T4) and untreated seeds (T5) for 28 and 25 weeks respectively. But these were not significantly ($p < 0.05$) different when compared with those from scarifying seeds (T3) and soaking seeds in hot water for 10 minutes (T6).

The results show that germination percentage was significantly ($P < 0.05$) affected by different seed pre-sowing techniques (Table 1). The highest germination percentage was

recorded from seeds scarifying and soaking in cold water for 12 hours (60.7%) followed by scarifying and soaking in hot water for 10 minutes (46.7%), scarifying seeds (41.7%), soaking in cold water for 12 hours (38.9%),

untreated seeds (27.8%) and soaking by hot water (23.3%). There were no significant differences among T2, T3, and T4, but these differed significantly ($p<0.05$) from (T1), (T5), and (T6).

Table 2: Effect of different pre-sowing techniques on germination of *Adansonia digitata* seeds in the nursery.

Treatments	De	Gpd (weeks)	Gp (%)
(T1) Scarifying and soaking seeds in cold water for 12hrs	9 ^b	12 ^c	60.7 ^a
(T2) Scarifying and soaking seeds in hot water for 10 min	11 ^{bc}	12 ^c	46.7 ^b
(T3) Scarifying seeds only	15 ^b	20 ^b	41.7 ^b
(T4) Soaking seeds in cold water for 12hrs	12 ^{bc}	28 ^a	38.9 ^b
(T5) Control (untreated seeds)	37 ^a	25 ^{ab}	27.8 ^c
(T6) Soaking seeds in hot water for 10 min	15 ^b	22 ^{ab}	23.3 ^c
Mean	16.5	19.8	39.8
LSD (0.05)	*	*	*
CV%	14.2	19.5	13.2

Note: De=Days of emergency, Gpd= Germination period in weeks, Gp= Germination percentage

3.3.Effect of Watering Regime Frequency on Growth Parameters of the Baobab Seedling Height

At the end of the growth study, the highest height was recorded in daily watering (21.7cm) followed by watering in three days (13.1cm) and the least value was recorded in watering in 14 days (7.4cm). Watering regimes have significant effect ($p<0.05$) on seedling height. However, there were no significant differences between T2 and T3, T3 and T4 (Table 3).

3.4.Effect of Watering Regime on Early Growth (Root Collar Diameter and Height)

Watering frequency had a significant ($p<0.05$) effect on seedling diameter growth. The highest diameter had been scored on daily watering (0.6cm) and water in 3 days intervals (0.6cm). This was significantly different with seedlings that were watered in 7 and 14 days. However, values of watering in 7 and 14 days were statistically similar (Table 4).

3.5.Number of leaves

The watering frequency had a significant ($P<0.05$) effect on the seedling number of leaves. After three-months, seedlings which were watered daily have significantly ($p<0.05$) higher number of leaves (21) than those seedlings watered in 03, 07 and 14 days interval. In addition, there was no significant difference between seedlings watered at 7 and 14 days interval.

Table 3: Effect of the watering regime on seedling height (cm)

Treatments	Initial data	One month	Two months	Three months
T1(Daily watering)	3.8	9.8 ^a	15.8 ^a	21.7 ^a
T2(watering in 3 days)	4.0	6.5 ^b	8.5 ^b	13.1 ^b
T3(watering in 7 days)	4.1	5.6 ^b	6.4 ^b	8.0 ^{bc}
T4(watering in 14 days)	4.3	5.4 ^b	5.7 ^b	7.4 ^c
Mean	4.0	6.8	9.1	12.5
LSD (0.05)	Ns	*	*	*
CV %	22	21	23	27

Table 4: Effect of the watering regime on seedling diameter (cm) and the number of leaves

Treatments	Initial data	One month		Two months		Three months	
	NL	NL	RCD	NL	RCD	NL	RCD
Daily watering	4	10 ^a	0.3 ^a	15 ^a	0.6 ^a	21 ^a	0.6 ^a
watering in 3 days	5	6 ^b	0.3 ^a	8 ^b	0.4 ^b	12 ^b	0.6 ^a
watering in 7 days	5	5 ^b	0.3 ^a	4 ^{bc}	0.3 ^{bc}	5 ^c	0.3 ^b
watering in 14 days	5	2 ^c	0.2 ^b	2 ^c	0.2 ^c	3 ^c	0.2 ^b
Mean	4.7	6	0.3	7	0.4	10	0.4
LSD (0.05)	Ns	*	*	*	*	*	*
CV %	14	17	23	27	23	31	35

Note: NL=Number of leaves/five seedlings, RCD=Root Collar Diameter

3.6. Fresh root, stem, and leaves weight

The fresh biomass of *Adansonia digitata* seedlings was significantly ($p<0.05$) affected by varying watering regimes. Fresh root weight (77.8 g) was highest in seedlings watered every day which is significantly ($p<0.05$) different from seedlings watered from 3, 7, and 14 days interval. While the least value was obtained in seedlings watered in 14 days intervals (2g). The fresh stem weight (30.3g) was recorded as highest in seedlings watered daily which is significantly ($p<0.05$) highest than seedlings watered in 3, 7, and 14 days. The watering frequency had a significant ($p<0.05$) effect on fresh leaves weight whereby seedlings that were watered daily had significantly higher fresh leaves weight (17g) ($p<0.05$) than those watered once in 03, 07, and 14 days (Figure 2).

3.7. The dry weight of the root, stems, and leaves of Baobab seedlings

Seedlings exposed to varying watering

frequencies had significant ($p<0.05$) differences in root dry weight whereas seedlings that received water once every day had the highest root dry weight (10g) which was significantly (0.05) different from those watered once in 03, 07 and 14 days interval (Figure 4). Seedlings watered everyday had significantly ($p<0.05$) highest stem dry weight (7.8g) followed by seedlings that were received once in 3 days (2.8g) and significantly differed with watering once after 3, 7, and 14 days (Figure 4). A significant effect was observed on dry leaves weight and seedlings watered once a day had scored the highest dry leaves weight followed by watering once in 3 days (1.9g) and significantly ($p<0.05$) differed from watered once in 03, 07, and 14 days while the least value was recorded on watered once in 14 days (0.2g) (Figure 4).

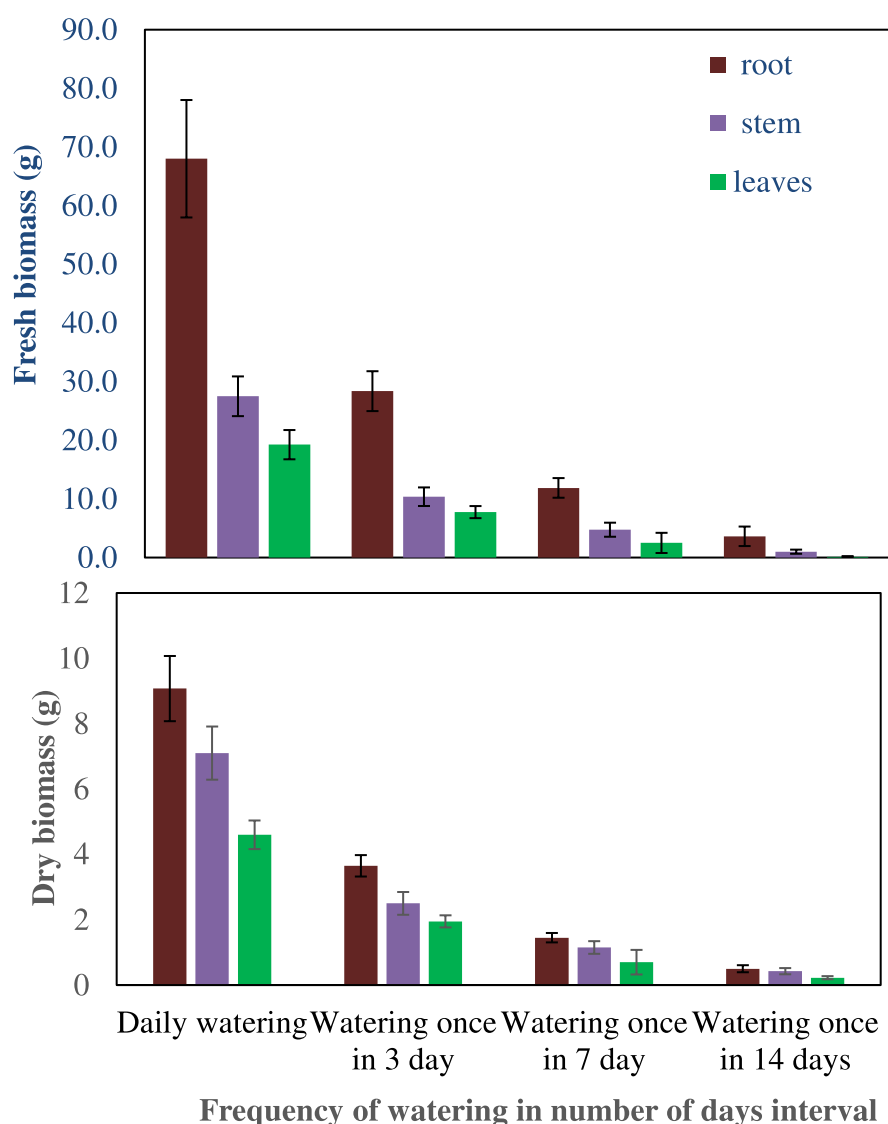


Figure 4: Effect of the watering regime on fresh weight (g) and dry weight (g) of Baobab seedlings.

3.8. The Germination Status of the Baobab Seeds at the Laboratory and Nursery Level

Seeds of many woody plant species cannot germinate even if they are sown under optimal moisture, oxygen, and soil conditions because of hard seed coat dormancy (Setlhabetsi et al 2019). Hard-coated seeds require some physical or chemical treatment to break dormancy to obtain maximum and rapid germination (Aliero et al 2016; Gilani et al 2019; Dewir et al 2011). Numerous studies have reported that pre-sowing treatments of seeds to break the hard seed coat significantly enhance the germination of various tree species (Olatunji et al 2013; Das 2014;

Setlhabetsi et al 2019).

In this study, the highest germination percentage was recorded in scarifying seeds and soaking them in cold water for 12 hours (60.7 %). This treatment is likely to have quickly softened the impermeable cover and allowed imbibition by the embryo. This is similar to the report of Gilani et al (2019) who reported that soaking seeds of *Acacia nilotica* and *Faihedrbia albida* in cold water improved germination percentages significantly. Nicking has been used effectively to break dormancy in many species by partially removing the seed coat (Setlhabetsi et al 2019; Dada et al 2019). This is in agreement with others who demonstrated that the nicking part of the hard seed coat prevents imbibition and gaseous exchange (Azad et al 2011). Nicking the seed

coat of *Peltophorum africanum* resulted in 85 and 88% germination compared with 30% in the untreated seeds (Mojeremane et al 2018).

Scarifying and soaking in cold and hot water of *Adansonia digitata* seeds were earlier germination could be due to cracks made on the seed creating an entry of water and exchange of gases, resulting in enzymatic hydrolysis and thus, transforming the embryo into a seedling. The result of this study conforms with the report of (Falemara et al 2014) who recorded that Seeds soaked in cold water emerged earlier, thus also reducing the dormancy period on *Adansonia digitata* seeds. Soaking seeds with hot water for 10 minutes and untreated seed treatments recorded the lowest germination percentage. Baobab seeds may be characterized by a very hard seed coat. Dada et al (2019); Setlhabetsi et al (2019) reported low germination in *Annona muricata* and *Philenoptera violacea* seeds treated in boiling water for 1, 3, and 5 minutes and control. Our study is also in line with the work of Mojeremane et al (2018) who reported that soaking *Peltophorum africanum* seeds in boiling water was not effective in improving seed germination.

Pre-sowing techniques used in *Adansonia digitata* significantly affected the germination period (Falemara et al 2014). The shortest period of germination was recorded in scarifying plus soaking seeds in cold water for 12 hours; and scarifying seeds and soaking with hot water for 10 minutes compared with the control. It indicated that baobab seeds might not be germinated efficiently without appropriate pre-sowing treatments. According to Danthu et al (1995), Baobab seeds have very hard seed coats and germination is usually less than 20% under natural condition. Even though it could be germinated under natural condition; the seed cover pods need to crushing the hard woody shell of the fruit and the seeds can be extracted from the dry acidic pulp through animals, birds and insects' dissection. This is in agreement with Adeniji et al (2019) who reported that scarification treatments improved the germination period. In addition, cold water; scarification, and boiling water are effective methods of improving germination percentage and period of germination (Mojeremane et al 2018).

3.9.Effect of Watering Frequency on the Growth Parameters of the Baobab Seedlings

Seedling's growth was significantly improved by watering frequency where watering once daily produced the highest growth (height, diameter, number of leaves, and biomass) over other watering frequencies. Seedlings that received water once after seven days and those watered once after fourteen days had lower growth rates but the species was able to withstand the water stress. This is confirmed by Mukhtar et al (2016) plant water status has a strong influence on plant growth and biomass production through its effect on leaf and root expansion. This implies that growth and biomass production is directly proportional to the supply and use of water (Mukhtar 2016). A previous study by Dada et al (2019) also showed that Insufficient water supply hindered the rapid development of *Tetrapleura tetraptera* seedlings.

The good seedling growth performance (height, root collar diameter, number of leaves, fresh and dry weight) was obtained from watering once daily and confirmed by Oboho (2017) on *Adansonia digitata* seedlings, who reported that seedling growth of *Adansonia digitata* was significantly affected by watering regime and watering once daily performed best in all parameter measured. This is also agreed with Daba and Tadesse (2017) who reported that watering enhances the growth of *Grevillea robusta*, *Moringa olifera*, and *Cordia africana*. The present study partially agreed with the result of Mukhtar (2016) who recorded that higher growth of *Adansonia digitata* seedlings was obtained from watered once daily but was similar to those watered once after three days. These findings are disagreed with the result of who recorded highest growth of *Parkia biglobosa* seedlings that were watered once in five days over seedlings watered once daily and once in three days. The species characteristics could be responsible for this variation (Sale 2015). This result also disagreed with the findings of Grace Ogun and Kayode (2018) who reported that the plant height of *Solanum macrocarpon* was not significantly affected by the watering regime. This could be due to differences in. This may be due to water requirement difference and the nature of Baobab seedling root, which is ability to store water in their

root and it tied over longer seasons.

4. CONCLUSIONS AND RECOMMENDATIONS

This study investigated the effect of six pre-sowing techniques on breaking seed dormancy and the germination response of *Adansonia digitata* seeds. It was revealed that scarifying seeds and soaking in cold water for 12 hrs have best germination and early days of emergency. Moreover, scarifying seeds and soaking them in hot water for 10 minutes gave the short mean days of seeds emergence. The highest significant germination percentage was also recorded in scarifying seeds and soaking in cold water for 12 hrs. Based on the findings of the research work, it is recommended that, scarifying seeds and soaking in cold water for 12 hours should be adopted to improve the period of breaking seed dormancy and enhance germination of *Adansonia digitata* seeds.

Furthermore, daily watering improves the growth parameters of baobab seedlings more than other watering frequencies. Daily watering produced the highest growth performances in *Adansonia digitata* seedlings

for all parameters assessed (height, root collar diameter, number of leaves, fresh and dry biomass). However, tolerating water stress, watering once after 7 and 14 days gave the lowest growth parameters. Hence, baobab seedling is anticipated attention to grow in the arid areas and to give good growth performance and biomass production. Therefore, the baobab seeds should be subjected for *scarification* and soaking them in cold water for 12 hours seedlings, as well as watered every morning at least 200 ml per plant.

ACKNOWLEDGMENTS

We express my deepest gratitude to Mr. Fisha Atnafe for great Support for seed collection and Alemu Tsegaye (former center director) their beneficial guidance, unceasing support. We also are very grateful for financial support from the Sekota Dry Land Agricultural Research Center/Amhara Region Agricultural Research Institute (ARARI).

REFERENCES

- Adeniji T, Olomola B and Jegede C (2019). Seed germination and seedling growth of *Ceiba Pentandra* (L) as influenced by different soil types in Ibadan, Southwest Nigeria. *Journal of Research in Forestry, Wildlife and Environment*, 11(3), 316-320.
- Azad S, Manik M R, Hasan S, and Matin A (2011). Effect of different pre-sowing treatments on seed germination percentage and growth performance of *Acacia auriculiformis*. *Journal of Forestry Research*, 22, 183-188.
- Aliero M M an Bunza M R (2016). The growth of *Balanites aegyptiaca* (L .) seedlings under varied watering intervals in the nursery. <https://doi.org/10.4314/as.v15i3.5>
- Azene B, and Tengnäs B (2007). *Useful Trees and Shrubs of Ethiopia: Identification, Propagation, and Management for 17 Agroclimatic Zones*. Nairobi Kenya: RELMA in ICRAF Project.
- Bilcke N, Van Den, Smedt S, Simbo D J and Samson R (2013). Sap flow and water use in African baobab (*Adansonia digitata* L .) seedlings in response to drought stress. *South African Journal of Botany*, 88, 438–446.
- Chadare F J (2010). *Baobab (Adansonia digitata L .) foods from Benin: composition , processing and quality*. Wageningen University.
- Daba M H and Tadesse A E (2017). Estimation of optimum water requirement and frequency of watering for different tree seedlings at Bako Agricultural Research Center nursery site. *Journal of Health and Environmental Research*, 3(6), 90-97.
- Dada C A, Kayode J, Arowosegbe S and Ayeni M J (2019). Effect of scarification on breaking seed dormancy and germination enhancement in *Annona muricata* L.(Magnoliales: Annonaceae). *World Scientific News*, 126, 136-147.
- Danthu P J, Roussel A, Gaye and E H E (1995). Baobab (*Adansonia digitata* L.) seed pretreatments for germination improvement. *Seed Science and Technology*, 469–475.

- Das N (2014). The effect of seed sources variation and presowing treatments on the seed germination of *Acacia catechu* and *Elaeocarpus floribundus* species in Bangladesh. *International Journal of Forestry Research*.
- Dewir Y H, El-Mahrouk M E, and Naidoo Y (2011). Effects of Some Mechanical and Chemical Treatments on Seed Germination of *Sabal palmetto* and *Thrinax morrisii* Palms. *Australian journal of crop science*, 5(3), 248-253.
- Falemara B C, Chomini and Udenkwere D M (2014). Pre-Germination and Dormancy Response of *Adansonia Digitata* L Seeds To Pre-Treatment Techniques and Growth Media. *European Journal of Agriculture and Forestry Research*, 2(1), 31-41.
- Gebauer J, El-Siddig K, and Ebert G (2002). Baobab (*Adansonia digitata* L.): a review on a multipurpose tree with promising future in the Sudan. *Gartenbauwissenschaft*, 67(4), 155-160.
- Gilani M M, Irfan A, Farooq T H, Wu P, Yousaf MS, Khan M W and Ma X (2019). Effects of pre-sowing treatments on seed germination and morphological growth of *Acacia nilotica* and *Faidherbia albida*. *Scientia Forestalis*, (122), 374-382.
- Grace O D and Kayode J (2018). Effect of watering regimes on early seedling growth of *Solanum macrocarpon* L.(Solanaceae). *Journal of Applied Sciences*, 18(2), 79-85.
- Kamatou G P, Vermaak I and Viljoen A M (2011). An updated review of *Adansonia digitata*: A commercially important African tree. *South African Journal of Botany*, 77(4), 908-919. doi:10.1016/j.sajb.2011.08.010
- Mojeremane W, Mathowa T and Teketay D (2018). Effects of different pre-sowing treatments on germination of *Peltophorum africanum* Sond. seeds from two provenances in Botswana. *Journal of Biodiversity and Environmental Sciences*, 12(2), 230-236.
- Mukhtar R B, Mansur M A, Abdullahi S and Bunza M S (2016). The growth of *Balanites aegyptiaca* (L.) seedlings under varied watering intervals in the nursery. *Agro-Science*, 15(3), 30-33.
- Mukhtar R B (2016). Effect of drought stress on early growth of *Adansonia digitata* (L.) in semiarid region of Nigeria. *Journal of Research in Forestry, wildlife and Environment*, 8(4), 109-115.
- Oboho E G and Ahanon E C (2017). Effect of different pre-treatments on seed germination and watering regime on growth of *Adansonia digitata* (Linn.) seedlings. *Asian Journal of Science and Technology*, 8(4), 4569-4573.
- Olatunji D, Maku J O and Odumefun O P (2013). The effect of pre-treatments on the germination and early seedlings growth of *Acacia auriculiformis* Cunn. Ex. Benth. *African journal of plant science*, 7(8), 325-330.
- Rama S N, Shama N, Samatha T M and S K (2017). Effect of pre-treatment on dormancy and in vitro seed germination in globally endangered forest tree *Adansonia digitata*. *Journal of Biotechnology and Biochemistry*, 3(5), 45-52.
- Sale F (2015). Evaluation of Watering Regimes and Different Pot Sizes in The Growth of *Parkia biglobosa* (Jacq) Benth Seedlings Under Nursery Condition. *European Scientific Journal*, 11(12), 313-325.
- Setlhabetsi O T, Mojeremane W, Mathowa T, and Teketay D (2019). Breaking seed dormancy in *Philenoptera violacea* (Koltzsch) Schire using different pre-sowing treatment methods. *Journal of Agriculture and Environmental Sciences*, 8(1), 104-110.
- Sidibe M and Williams J T (2002). *Baobab Adansonia digitata* L. RPM Reprographics, Chichester, England.