Effect of Pre-Sowing Treatment on Seed Germination and Seedling Early Growth Performance of *Faidhaerbia albida* (GAWO)

Ambursa A.S[1]., Atiku M[1]., D.P. Gwimmi[1], U. Illiyasu[1], M.A. Mansur[1], and A. Abdulrahman[2]..
[1]Department of Forestry and Fisheries,
Kebbi State University of Science and Technology, Alliero.
[2]Department of Agricultural Technology,
College of Agriculture and Technology, Bakura.
Corresponding author: ambursa1984@gmail.com
aasarki@gmail.com

D.O.I: 10.56201/ijaes.v9.no7.2023.pg32.40

Abstract

The experiment was carried out in the Department of Forestry and Fisheries at tree seedlings Nursery, Kebbi State University of Science and Technology Aleiro and Viable seeds of Faidherbia albida were obtained from the Department of Forestry and Fisheries, Kebbi State University of Science and Technology Aleiro. The treatments were carried out in the field using Randomize Complete Block Design (RCBD), replicated six times treatment combinations used are H_2SO_4, HCL, and cold and hot water respectively. The best germination percentage was observed in sulphuric acid (88.8%) followed by hydrochloric acid (78.8%) and cold water-treated seeds produced the lowest germination percentage of (55.5%). The result for pre-sowing on several leaves differs significantly ($P<0.05$) between all the treatments. Hydrochloric Acid treatment produces the highest number of leaves (13.00) which is similar ($P>0.05$) to the sulphuric acid result (12.00) but differs significantly ($P<0.05$) from all other treatments. While hot water treatment produced the least number of leaves. The result for collar diameter revealed significant ($P<0.05$) decreases in scarified seeds (0.87mm) and hot water treatment (0.30mm) compared with control (1.85mm). However, plant height revealed significant ($P<0.05$) increases in sulphuric (22.70) and hydrochloric acid treatment (19.27) compared to control (8.33). Hence this study validates the use of sulphuric acid and hydrochloric acid and further supports the use of these methods as an alternative in propagating and preservation Faidherbia albida

***Keywords**: Faidherbia, seeds, pre-sowing, leaves, propagatin, collar, germination, treatments, plant, height,*

INTRODUCTION

Seed germination is one of the main difficulties in propagating wild plants. The cause is attributed to the intense suffering latency, which may be due to an undeveloped embryo, a thick covering of the seed that interferes with the absorption of water and oxygen, and resistance to the growth of the embryo (Masclaux et *al*.,2010). Bewley and Black, (2012) absorbed that seeds of these fruits take longer to germinate and often lose their viability as they age because, over time, the embryo shrinks from lack of moisture, so the germination stage takes longer because it has to absorb water to return to its original proportions.

Faidherbia albida (Delile) A. Chev. (Synonym *Acacia albida*) is a multipurpose agroforestry tree species indigenous to Africa. It belongs to the monotypic genus Faidherbia of Fabaceae (Leguminosae). It is a natural fertilizer factory supplying the equivalent of 300 kilograms of complete fertilizers and 250 kilograms of lime boosting soil fertility due to its peculiar reverse phenology and increasing productivity in farms where the plant has been adopted by 13% as well as an increase in nutrient content, especially in millet, due to leaf fall at the onset of the rainy season (Chuyong and Acidri, 2014). Many farmers in the arid and semi-arid regions have adopted agroforestry practices incorporating the plant because the tree does not compete with plants for light, nutrients and water.

Leaves, pods and seeds are a very good source of fodder providing 200, 150 and 260g per kilogram of total protein of dry matter, respectively, with total protein digestibility reaching 73% (Ong*et al*., 2007). The tree also serves as a shade or shelter for crops in the farms and livestock during the dry season, as a useful ornamental tree for gardens and avenues, as boundary/barrier/support, and as windbreaks, apiculture, fuel wood and charcoal, as a source of timber, as fibre and source of dye (Chuyong and Acidri, 2014). Extracts from the bark and roots of the tree are used in the treatment of respiratory and digestive disturbances in addition to its use in the treatment of malaria and other fevers.

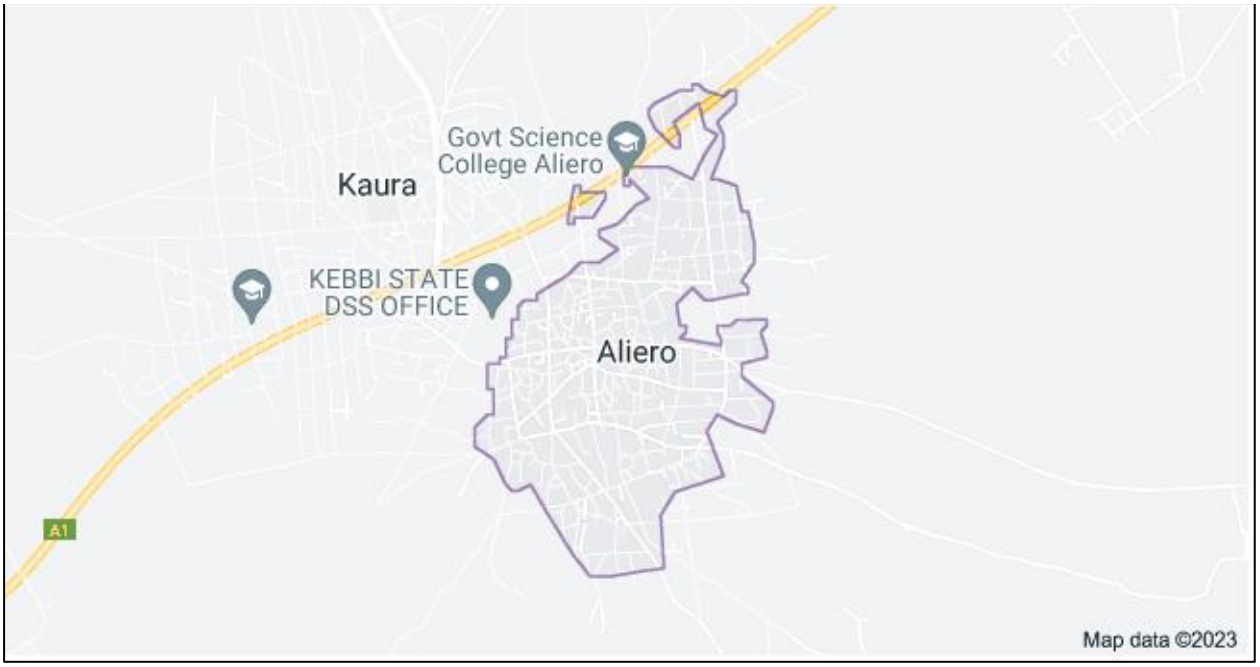
For plants to efficiently propagate, germination is a requirement. Though seed dormancy is often considered an impending factor, many plants use it as a survival mechanism which ensures that germination occurs only during favourable conditions (Rubio *et al*., 2017). Many scholars have proposed pre-sowing treatment methods targeted at breaking seed dormancy in seeds with physical dormancy such as scarification by nicking, hot water, concentrated sulphuric acid, stratification, and many others (Munie*et al*., 2022). Studies carried out on seed treatments in the plant have proposed and encouraged the adoption of the nicking and hot water treatments independently. Several environmental factors such as temperature, salinity, light, and soil moisture simultaneously influence seed germination (Huang *et al*., 20003). Among several factors, temperature has been considered the most important. The variation in the optimal temperature for seed germination depends on the considered species, and for the majority of species, seed germination occurs over a wide range of temperatures (Dürr*et al*., 2015). This variation in the optimal temperature and the germination percentage between species constitutes some adaptive strategies to harsh environmental conditions. It has been shown that temperatures above the thermal optimum often provoke an inhibition of germination and irreversible damage (Essemine*et al*., 2010).

The main aim of the research is to determine the effect of pre-sowing treatment on germination and early growth performance of *Faidherbia albida*

MATERIALS AND METHODS

Study Area

The experiment was carried out in the Department of Forestry and Fisheries at tree seedlings Nursery, Kebbi State University of Science and Technology Aleiro. Aleiro is located at latitude $12^{0}30^{1}61^{11}$N and longitude $4^{0}49^{1}20^{11}$E, Aliero Local Government shares common borders with Gwandu Local Government area in the Northern, Jega Local Government area in the Southwest and East Tambuwal Local Government of Sokoto State. The North West is by BirninKebbi Local Government (Uzondo, 2007).



The topography is flat and slightly undulating with compact, stony brown soil Aliero has savannah vegetation. There are two major seasons, the dry season lasts from November to April and the rainy season from May to October. The harmattan period starts from November to January characterized by heavy fog, dust and cold. However, the months of March and April are the hottest (Uzondu, 2007). Minimum temperature of 38 - 42°C in November. The temperature is low during the harmattan (December-February) with a mean temperature of 20 to 23°C and humidity between 17-80% respectively (Abubakar, 2021).

Collection and Preparation of Materials

Viable seeds of *Faidherbia albida* were obtained from the Department of Forestry and Fisheries, Kebbi State University of Science and Technology Aleiro. The Nursery soil was obtained from the Department of Forestry and Fisheries, Kebbi State University of Science and Technology Aleiro. Conc H_2SO_4 and sandpaper were obtained from the Department of Forestry and Fisheries, Kebbi State University of Science and Technology Aleiro, Laboratory.

Methodology

Experimental Design and Description of Treatment

The treatments were carried out in the field using Randomize Complete Block Design (RCBD), replicated six.

Treatment 1 Using cold water; *Faidherbia albida* seed was soaked in cold water for 12 hours before sowing.

Treatment 2 Using hot water; the water was boiled for 15mins and the seed was soaked in hot water for a further 15mins.

Treatment 3 using concentrated H_2So4; *Faidherbia albida* seed was soaked in concentrated H_2S04 solution for 10 minutes and washed with plenty of water for a further 10 minutes.

Treatment 4 The seed of *Faidherbia albida* was scarified on both sides using sandpaper before sowing to encourage water take-off by the seed.

Treatment 5 *Faidherbia albida* seed was soaked in concentrated HCL for 10 minutes and was washed with plenty of water for a further 10 minutes.

Treatment 6 Normal control (untreated seeds) treatment was applied the seed was directly sown into to polythene bag.

Data Collection

The data was collected basically on the following parameters; the germination percentage, plant height, colar diameter and number of leaves.

Germination Percentages

Germination was observed for 8 weeks and the number of seeds germinated in each treatment was recorded every week. Germination was observed in the seeds when the first radicle emerged. At the end of the germination period, the germination percentage was calculated using the following formula

Germination percentages: $\frac{Numberofseedgerminated}{Numberofseedsplanted} \times 100$

Measurement of Growth Parameters

Growth parameters to be examined are plant height (cm), collar diameter (mm) and number of leaves (NOL).

(i) Plant height

The plant height was measured using the meter rule from the base of the plant to the tip of the leaf weekly.

(ii) Number of leaves

The number of leaves was obtained by visual counting of the leaves, the leaves of ten (10) plants were randomly selected per group every week.

(iii) collar diameter

Statistical Analysis

The data generated from the study was presented as Mean ± Standard deviation and was subjected to one-way analysis of variance (ANOVA), using SAS and the statistical difference

between means was separated using least significant difference (LSD) at a 5% level of significant.

RESULTS

The germination percentage of *F. albida* treated with various pre-sewing methods is presented in Figure 4.1. The best germination percentage was observed in sulphuric acid (88.8%) followed by hydrochloric acid (78.8%) and cold water-treated seeds produced the lowest germination percentage of (55.5%).

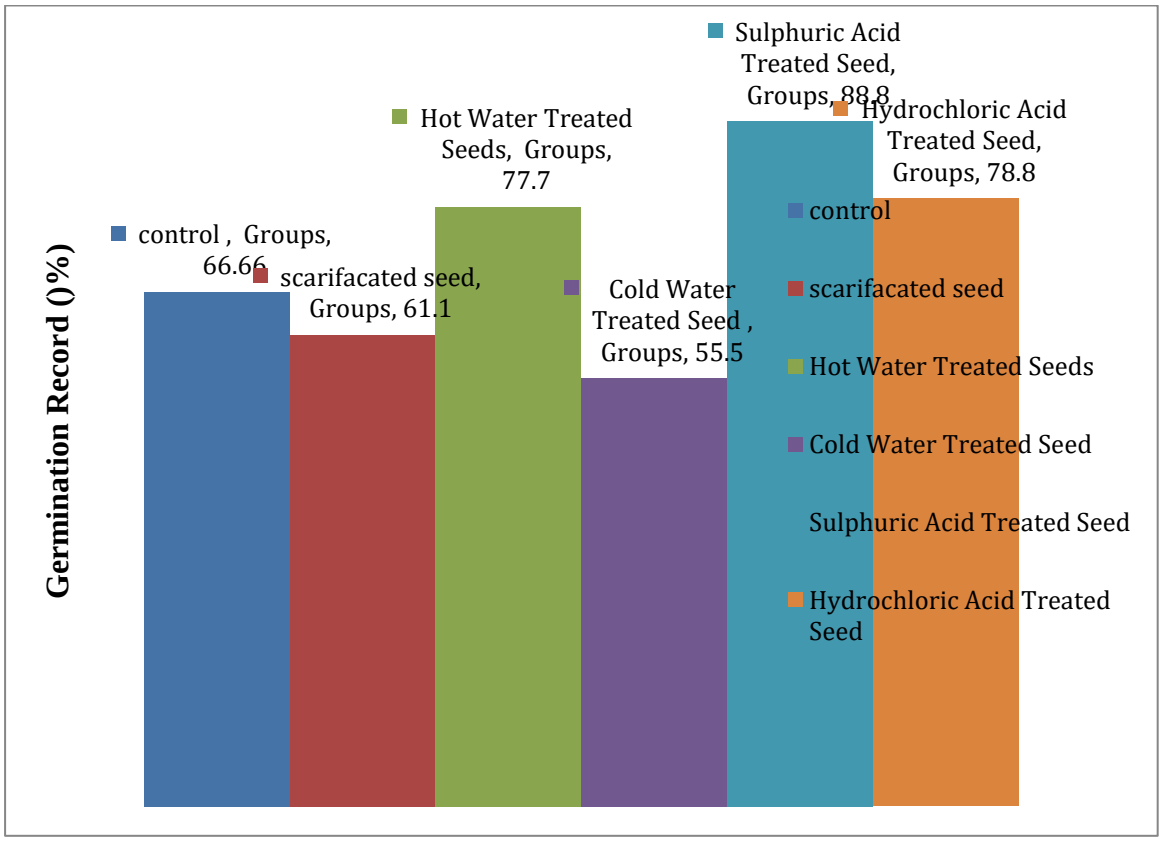


Figure 1: Germination Record of *F. albida* Seed Treated with Different Pre-sewing Treatments

Effect of Pre-sowing Treatment on Number of Leaves, Colar Diameter and Plant Height

The results for pre-sowing on several leaves differ significantly ($P<0.05$) between all the treatments. Hydrochloric Acid treatment produces the highest number of leaves (13.00) which is similar ($P>0.05$) to sulphuric acid result (12.00) but differs significantly ($P<0.05$) with all other treatments. While hot water treatment produced the least number of leaves. The result for colar diameter revealed significant ($P<0.05$) decreases in scarified seeds (0.87mm) and hot water treatment (0.30mm) compared with control (1.85mm). However, plant height revealed significant ($P<0.05$) increases in sulphuric (22.70) and hydrochloric acid treatment (19.27) compared to control (8.33).

Effect of Pre-sowing Treatment on Number of Leaves, Colar Diameter and Plant Height

Treatments	Number of Leaves	Colar Diameter mm	Plant Height Cm
Control	9.33 ± 3.68^{ab}	1.85 ± 0.49^{c}	8.33 ± 3.2^{a}
Scarificated Seed	11.33 ± 13.66^{b}	0.87 ± 0.99^{ab}	9.57 ± 0.10^{a}
Hot water Treatment	3.16 ± 4.31^{a}	0.30 ± 0.07^{a}	3.17 ± 0.67^{a}
Cold water Treatment	9.00 ± 4.00^{ab}	1.38 ± 0.71^{bc}	6.35 ± 3.75^{a}
Sulphuric acid Treatment	12.00 ± 1.54^{b}	1.63 ± 0.12^{bc}	22.70 ± 2.51^{b}
Hydrochloric Acid treatment	13.00 ± 1.41^{b}	1.57 ± 0.18^{bc}	19.27 ± 1.73^{b}
LSD	6.16	1.55	3.43

Values are presented as mean ± standard deviation, and values having the same letters in the column are not significantly different (P>0.05).

DISCUSSION

Orwa *et al*. (2009) reported that seed morphology, anatomy and environmental factors affect the effective and sustainable germination of seeds which invariably helps to ensure successful plant propagation. Seeds soaked in Conc.H_2SO_4, had the highest germination percentage. This may be the result of acid-corrosive action to soften the seed coat. This study agrees with the finding of Gilani *et al*. (2019), corroborating the findings of Chuyong and Acidri (2015) who reported significant differences in the treatments applied to treatments applied to the seeds of *F. albida*. The result obtained for this study on the germination value shows that the seeds soaked in Conc. H_2SO_4 for 15 minutes gave the best germination. This might be due to the fast weathering off of the seed coat which allowed quick penetration of water into the seeds. Aliero, (2004) stated the importance of sulphuric acid pre-treatment in the germination *of Parkia biglobosa* seeds. Mechanical scarification, and treatment with sulphuric acid and HCL were very effective in increasing seed germination and shortening the seed germination period. Scarification treatment on *F. Albida* seeds was able to increase water absorption by seeds which were previously hampered by the thickness and hardness of the seed coat so that water could not enter the seed tissue (Dumroese *et al*., 2016).

Growth Performance

Several factors affect emergence as well as germination percentage and sowing depth has been identified as one of such factors (Minore, 1985; Koger*et al*., 2004). Fredrick *et al*. (2017) stated that pre-sowing affected the number of leaves, colar diameter and plant height and their findings were in line with the present study where a similar result was found. The reason for this performance may be early germination caused by the acid treatment. Several previous studies reported that seed scarification could increase and accelerate the germination of forest plant seeds, number of leaves, colar diameter and plant height (Azad *et al*.,2012; Nongrum and Kharlukhi 2013; Azad *et al*., 2013; Fredrick *et al*., 2017).

Summary

All the methods normal control, scarification, hot water, cold water, sulphuric and hydrochloric revealed a percentage growth of 666, 61.1, 77.7, 55.5, 88.8 and 78.8% respectively. The result for pre-sowing on several leaves revealed an increase in all treatments compared to control although the increases are not significant. Hence this study validate the use of chemical and

other traditional method in pre-sowing and further support the use of this method as an alternative to managing and preserving plants.

Conclusion

The present study showed the best germination percentage in sulphuric acid and hydrochloric acid. Similarly number of leaves, collar diameter and plant height of sulphuric acid and hydrochloric treated groups showed higher number and length respectively. Hence this study validates the use of sulphuric acid and hydrochloric acid and further supports the use of this method as an alternative in propagating and preserving *Faidherbia albida*.

Recommendation

Based on the findings of this study, the following are recommended for subsequent research

i. Conc. Sulphuric acid and HCL are recommended as the best treatments treatment for *Faidherbia albida germination and early growth performance*
ii. Similar research needs to be conducted to validate this result

REFERENCES

Aliero, B. L. (2004). Effects of sulphuric acid, mechanical scarification and wet heat treatments on germination of seeds of African locust bean tree, Parkiabiglobosa. *African Journal of Biotechnology*, *3*(3), 179-181.

Ashraf, M., and Foolad, M. R. (2005). Pre-sowing seed treatment—A shotgun approach to improve germination, plant growth, and crop yield under saline and non-saline conditions. *Advances in agronomy*, *88*, 223-271.

Azad, M. S., Biswas, R. K., and Matin, M. A. (2012).Seed germination of Albiziaprocera (Roxb.)Benth.in Bangladesh: a basis for seed source variation and pre-sowing treatment effect. *Forestry Studies in China*, *14*, 124-130.

Azad, M. S., Nahar, N., and Matin, M. A. (2013). Effects of variation in seed sources and pre-sowing treatments on seed germination of Tamarindusindica: a multi-purpose tree species in Bangladesh. *Forest Science and Practice*, *15*, 121-129.

Bernard, J. (2002). Crop-weed interactions in the Beta vulgaris complex at a local scale: allelic diversity and gene flow within sugar beet fields. *Theoretical and Applied Genetics*, *104*, 688-697.

Bewley, J. D., and Black, M. (2012).*Physiology and biochemistry of seeds about germination: volume 2: viability, dormancy, and environmental control*. Springer Science and Business Media.

Cai, H. W., and Morishima, H. (2000). Genomic regions affecting seed shattering and seed dormancy in rice. *Theoretical and Applied Genetics*, *100*, 840-846.

Chuyong, G., and Acidri, T. (2014).Combining pre-sowing treatments in Faidherbiaalbida (Delile) A. Chev.does not imply better germination success. *Methodology*.

Chuyong, G., and Acidri, T. (2015).Combining pre-sowing treatments in Faidherbiaalbida (Delile) A. Chev.does not imply better germination success. *International Journal of Plant and Soil Science*, *8*(1), 1-6.

Debeaujon, I., Léon-Kloosterziel, K. M., and Koornneef, M. (2000). Influence of the testa on seed dormancy, germination, and longevity in Arabidopsis. *Plant Physiology*, *122*(2), 403-414.

Dumroese, K. R., Landis, T. D., Pinto, J. R., Haase, D. L., Wilkinson, K. W., and Davis, A. S. (2016). Meeting forest restoration challenges: using the target plant concept. *Reforesta*, *1*(1), 37-52.

Dürr, C., Dickie, J. B., Yang, X. Y., and Pritchard, H. W. (2015).Ranges of critical temperature and water potential values for the germination of species worldwide: contribution to a seed trait database.*Agricultural and forest meteorology*, *200*, 222-232.

Essemine, J., Ammar, S., and Bouzid, S. (2010). Impact of heat stress on germination and growth in higher plants: Physiological, biochemical and molecular repercussions and mechanisms of defence. *Journal of Biological Sciences*, *10*(6), 565-572.

Fredrick, C., Muthuri, C., Ngamau, K., and Sinclair, F. (2017).Provenance and pretreatment effect on seed germination of six provenances of Faidherbiaalbida (Delile) A. Chev.*Agroforestry Systems*, *91*, 1007-1017.

Garba, Z. N., Gimba, C. E., and Emmanuel, P. (2013).Production and Characterisation of Biobased Transformer Oil from JatrophaCurcas Seed.*Journal of Physical Science*, *24*(2).

Gilani, M. M., Irfan, A., Farooq, T. H., Wu, P., Yousaf, M. S., Khan, M. W., ...and Ma, X. (2019). Effects of pre-sowing treatments on seed germination and morphological growth of Acacia nilotica and Faidherbiaalbida.*ScientiaForestalis*, (122), 374-382.

Huang, Z., Zhang, X., Zheng, G., and Gutterman, Y. (2003). Influence of light, temperature, salinity and storage on seed germination of Haloxylonammodendron. *Journal of Arid Environments*, *55*(3), 453-464.

Iroko, O. A., Sowunmi, I. L., Ajekiigbe, J. M., Rufiai, S. O., and Wahab, W. T. (2021).Seed Germination of Faidherbiaalbida (Delile) A. Chev as Influenced by Different Pretreatments.*Journal of Applied Sciences and Environmental Management*, *25*(7), 1305-1309.

Keshtkar, A. R., Keshtkar, H. R., Razavi, S. M., andDalfardi, S. (2008). Methods to break seed dormancy of Astragaluscyclophyllon.*African Journal of Biotechnology*, *7*(21).

Koger, C. H., Reddy, K. N., and Poston, D. H. (2004). Factors affecting seed germination, seedling emergence, and survival of texasweed (Caperoniapalustris). *Weed Science*, *52*(6), 989-995.

Masclaux-Daubresse, C., Daniel-Vedele, F., Dechorgnat, J., Chardon, F., Gaufichon, L., and Suzuki, A. (2010). Nitrogen uptake, assimilation and remobilization in plants:

challenges for sustainable and productive agriculture. *Annals of Botany*, *105*(7), 1141-1157.

Minore, D. (1985). Effects of sowing depth on emergence and growth of Douglas-fir, western hemlock, and noble fir seedlings.*Canadian Journal of Forest Research*, *15*(5), 935-940.

Muncie, S. A., Habrová, H., Houšková, K., and Karas, L. (2022).Effect of Different Presowing Treatments to Break Seed Dormancy and Seed Collection Methods on the Germination of Dracaena steudneriSchweinf.Ex Engl. *Forests*, *13*(8), 1232.

Nongrum, A., and Kharlukhi, L. (2013).Effect of seed treatment for laboratory germination of Albizia chinensis. *Journal of Forestry Research*, *24*, 709-713.

Ong, C. K., Black, C. R., and Muthuri, C. W. (2007).Modifying forestry and agroforestry to increase water productivity in the semi-arid tropics.*CABI Reviews*, (2006), 19-pp.

Orwa, C., Mutua, A., Kindt, R., Jamnadass, R., and Simons, A. (2009).Agroforestry Database: a tree reference and selection guide. Version 4. *Agroforestry Database: a tree reference and selection guide. Version 4.*

Quayle, S., Arnold, R., Gunn, B., and Mohns, B. (2001).Tree nursery manual for the Sri Lankan plantation industry. *Estate Forest and Water Resources Development Project, Kandy*.

Rubio de Casas, R., Willis, C. G., Pearse, W. D., Baskin, C. C., Baskin, J. M., and Cavender-Bares, J. (2017). Global biogeography of seed dormancy is determined by seasonality and seed size: a case study in the legumes. *New Phytologist*, *214*(4), 1527-1536.

Sadhu, M. K. (1989).*Plant propagation*.New Age International. 200pp

Shaw, N., Barak, R. S., Campbell, R. E., Kirmer, A., Pedrini, S., Dixon, K., and Frischie, S. (2020). Seed use in the field: delivering seeds for restoration success. *Restoration Ecology*, *28*, S276-S285.

Walters, C., Towill, L., and Collins, C. O. (2004).Seeds and pollen.*Agriculture Handbook. The Commercial Storage of Fruits, Vegetables, and Florist and Nursery Stocks*, 735-743.

Werker, E. (1980). Seed dormancy is explained by the anatomy of embryo envelopes. *Israel Journal of Botany*, *29*(1-4), 22-44.