Bima Journal of Science and Technology, Vol. 7 (4) Dec, 2023 ISSN: 2536-6041

DOI: 10.56892/bima.v7i4.547

Breaking Dormancy of *Tamarindus indica* Seeds Using Diverse Mechanisms

[1]*Amina H. Aliyu, [1]Auwal Fatima Mato, [1]Nafi'atu Abdullahi and [1]Sulaiman Mohammed

Department of Biological Science, Gombe State University, P.M.B 027, Gombe, Gombe State. Nigeria

Corresponding Author: aliyuamina@gsu.edu.ng

ABSTRACT

Many Savannah tree species had dormant seeds and their germination is important for the plant growth and development. To achieve easy germination, this study determined the effect of seed dormancy and its breakage in *Tamarindus indica* (Tamarind) using diverse treatments for the seed domancy breakage. Fifty (50) seeds of Tamarind were subjected to four different treatments including mechanical abrasive, soaking in 50% concentrated sulphuric acid (H_2SO_4), soaking in cold and hot water, then control. The seeds were planted in polythene bags containing same type and amount of soil for germination and growth performance analysis. The seeds were allowed to grow for 8 weeks period. Mechanical scratchy gave the optimum germination performance at 100%, followed by seeds treated with hot water (80%) and the least germination performance was observed in the control. Whereas, no germination was observed from the seeds treated with sulphuric acid. Seedlings germinated from mechanical mechanism of seed dormancy breakage continue to give the best growth performance based on number of leafs per seedling, plant height and stem girth at interval of 2 weeks observation. Germination was observed to be enhanced by the effect of mechanical method on disrupting the seed coats of Tamarind. The statistically analysis at 5% significance level indicated that each treatments has significant effect on germination and growth performance of Tamarind seed. This would serve as basic information in the regeneration and improvement of Tamarind tree, as well as other native tree species that are of economic values.

Keyword: *Tamarindus indica*, Seed Dormancy, Mechanic Abrasive, Growth Performance

INTRODUCTION

Dormancy is an obstacle to germination which has taken place in a different way across species as a result of adaptation based on dominant environmental factor, in such a way that germination occur in only conditions for starting up a new plant generation is likely suitable (Finch and Leubner, 2006; Boroujerdnia, M., and Hasanzadeh, 2021, Abubakar et al., 2022). Different range of dormancy mechanisms has progressed in keeping with the change of climates and habitat in which they function. Generally, seed dormancy may be expressed as a block which may slow down the completion of an intact viable seed under favourable environmental condition (Finch and Leubner, 2006). A seed which is said to be dormant does not usually have the capacity/ability to germinate within a specified time under any condition, such as physical environmental factors which are optimal for its germination that is after the seed become non-dormant (Alabi et al., 2019).

Further, any seed which germinate over the widest range of normal physical environmental factors possible for the genotype is said to be completely non-dormant. Dormancy is a seed characteristic which describes the conditions required for germination and therefore any one that broadens the environmental requirement for germination should be considered as dormancy release factor. A wide range of factors can consequently alter germination, precisely physiological seed dormancy, e.g. temperature, light, nitrate or naturally

DOI: 10.56892/bima.v7i4.547

occurring chemical signals e.t.c.) (Finch and Leubner, 2006). Tamarind (*Tamarindus indica*, Family; Leguminosae), is an indigenous legume fruit tree of the tropics reported to be underutilized worldwide. *Tamarindus indica* possesses great potential to address various nutritional, healths, socioeconomic and environmental constraints (Azad et al., 2013; Ebifa-Othieno *et al*., 2017). It is important to rural communities as a major raw material for soft drinks and pharmaceuticals (Vikram et al., 2023) in the Northern part of Nigeria where it is known as Tsamiya (Van der Stege et al., 2011; Toungos et al., 2019), as well good source of pollination by insects (Ojo and Omoloye, 2021).

Notwithstanding the importance of *Tamarindus indica* for food, wood, and medicinal values, today only few stands of the species remained due to over exploitation without proper management and effective forest laws. In Nigeria, it is often exploited more or less in the wild. The aging tree stands are gradually dying without replacements and seeds do not germinate on their own accord, possibly due to lack of the factor that is required to break the dormancy (Muhammad and Amusa, 2003), although germination of seeds is often very difficult for many useful species mainly because of dormancy, to achieve the aim of any regeneration programme, seed collection and germination must be taken into consideration (Bello and Gada, 2015; Mohammed et al., 2018). Hence, it is necessary to identify the most appropriate way of raising seedlings under different seed treatment methods in the nursery. The purpose of the research is to examine the effect of Tamarind (*Tamarindus indica*) to pre-germination seed treatments and growth performance under normal environmental conditions.

MATERIALS AND METHODS

Tamarin Seed Collection and Treatment

The experiment was carried out in the Biological Garden of Biological Science Department, Gombe State University, Gombe Nigeria (Mohammed et al., 2016). The experiment was set-up with good viable seeds of Tamarind and were subjected to four methods of breaking seed dormancy as follows; Sulphuric acid of 50% concentration, mechanical scarification, hot and cold water treatment, and the control. Well-drained loamy soil was used for the planting and germination of the Tamarind seed under the above mentioned treatments.

Sampling and Viability Test

The seed samples were planted following random sampling technique (RST) in the four (4) different treatments. Seeds from the fruit were carefully extracted using a sharp knife and dipped in water in order to test for viability. Those seeds that sink or settle down at the bottom of the container were considered viable, while the floated ones were discarded. Ten (10) seeds were considered for each treatment (sulphuric acid, mechanical scarification, cold water, hot water) (Ayala et al., 2013; Azad et al., 2013; Muhammad and Amusa, 2003) and control which gives a total number of 50 sample seeds for the research.

Firstly, the seeds of the tamarind were soaked in a beaker containing sulphuric acid (H_2SO_4) of 50% concentration for 45 minutes and accompanied by regular stirring in order to ensure equal treatment of the seeds. The treated seeds were washed thoroughly with water and drained in moisten filter paper before direct sowing into the poly-pots for early germination and growth assessment (Ayala et al., 2013). For the mechanical scarification, the seeds were scarified by nicking the seed coat with knife before sowing directly into the poly pots.

Lastly, the seeds of the tamarind were soaked in a beaker containing hot water (100^0C for 30 minutes) with regular stirring,

DOI: 10.56892/bima.v7i4.547

then removed, and allowed to cool before sowing (Muhammad and Amusa, 2003). Similarly, same seed type were soaked in a beaker containing water for 2 hours at normal room temperature and then sown directly into the poly pots. Control seeds were not treated but sown into poly pots directly.

Seed Sowing and Growth Performance Analysis

The Tamarind seed were planted at 3cm depth as reported by Alabi et al., (2019). Watering was carried out once in a day (early morning) and twice in a day after complete germination (early morning and late evening). Germination percentage was recorded after cotyledon appearance which was computed using the following equation;

$$\text{Germination\%} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds planted}} \times 100$$

Measurement of Growth Characters

Growth height, stem diameter and leaf number was measured after two (2) weeks of germination. The growth characters were measured as follows; (a) growth height was measured using a metre ruler from the soil level to the tip of the seedling, (b) leaf number was determined by counting the number of leaves on the seedling. (c) stem diameter was measured using a measuring tape (Patel et al., 2018, Abubakar and Muhammad, 2022).

Statistical Analysis

Leaf number, growth height, and stem diameter frequencies were determined at 2-weeks interval. Induction frequency and growth was determined using specific formulae as demonstrated above, while difference of means was evaluated using SPSS version 18.0 [analysis of variance (ANOVA)] standard error (SE) (Alabi et al., 2019).

RESULTS AND DISCUSSION

Germination Assessment of *Tamarindus indica*

The germination results of the Tamarind seed treated with different methods of breaking seeds dormancy were recorded for a period of 8 weeks. Mechanical scarification treatment gave 50% germination after 8 days and showed a complete germination after 13 days and subsequently gave the highest germination percentage (100%), followed by hot and cold water treatment which resulted in 80% and 70% germination respectively (Table 1). However, the sulphuric acid (50% concentration) treatment gave 0% germination, whereas control seeds results to 30% germination also after 13 days as shown in Figure 1. All the above treatments were taken in order to soften the seed coat so that the embryo can germinate within a short period of time and proliferate. The result evidently shows that all the pre-treatment methods used are effective in hastening germination of Tamarind except for the sulphuric acid treatment (Parameswari et al., 2001; Alabi et al., 2019).

DOI: 10.56892/bima.v7i4.547

Table 1: Germination percentage at 13 days of *Tamarindus indica* seeds subjected to different treatments

Treatments	Number of seed sown	Number of seeds germinated	Germination %
Mechanical scarification	10	10	100
Hot water treatment	10	8	80
50% sulphuric acid	10	0	0
Control	10	3	30
Cold water treatment	10	7	70
F cal = 4.26			
p value = 0.04			
F tab = 4.20			

Macdonald and Conrad, (2015) stated that poor germination was recorded for sulphuric acid (H_2SO_4) treated Tamarind seeds which was due to charring and burning of seeds as a result of prolonged exposure. The results of the present study agrees with that of Abubakar and Muhammad, (2013) and Bello and Gada, (2015) who revealed that soaking of *Tamarindus indica* seeds in hot water at 100°C for 30 minutes had a percentage germination of 80% at the period of fifteen (15) and twelve (12) days after sowing respectively. The study also agrees with Muhammad and Amusa, (2003) who reported that hot water soaking gave higher percentage germination than ordinary water (cold water treatment).

This results are not in accordance with the findingds of Mozumder et al., (2018) and Muhammad and Amusa (2003), whom reported that seeds pre-treated with hot water had the lowest germination percentage and 50% sulphuric acid treated seed germinate. When the germination percentage of *Tamarindus indica* was taken for a period of 13 days after sowing, the seed treated with mechanical scarification performed much better in disrupting the hard seed coat. So based on this experiment, it is observed that mechanical scarification treatment have effect on emergence of tamarind seeds. The statistical analysis of the germination of *Tamarindus indica*, indicated that there is significant difference between the four (4) treatments (Saqib et al., 2023).

Effect of Pre-treatment on Number of Leafs

Growth in plant is the outcome of cell division, enlargement of the new cells and their differentiation into different types of tissues. These process of growth are accompanied by a permanent change in size (usually increase in the dry weight of the growing parts). The direct method was used to count the number of leaves emerged during data collection at the intervals of 2 weeks after the young cotyledon have emerged. Table 2 showed the result based on number of leafs of *Tamarindus indica* seedlings per two weeks interval (Reddy et al., 2023).

Table 2: Number of leafs from seedlings at two weeks interval

Treatments	2 weeks	4 weeks	6 weeks	8 weeks
Mechanical scarification	66	96	118	119
Hot water	47	78	80	83
50% sulphuric acid	-	-	-	-
Control	35	74	76	78
Cold water	45	71	92	99
F cal=0.65				
p value = 0.60				
F tab=3.49				

DOI: 10.56892/bima.v7i4.547

Based on the statistical analysis carried out on the number of leafs, it indicated that there is no significant difference between the treatments. As shown in Table 2, seeds treated with mechanical scarification gave the highest number of leafs as at 8 weeks (119 leafs) and the least was seeds that control having 78 leafs at a period of 8 weeks.

Effect of Pre-treatment on the Plant Height

The simpler method of measuring growth (direct method) was used during data collection, in which the length of growing part (shoot) was measured just with the help of centimetre ruler at the interval of 2 weeks after the seedling emergence. Table 3 showed the result based on number of plant height at 2 weeks interval.

Table 3: Plant height performance at 2 weeks interval

Treatment	2 weeks	4 weeks	6 weeks	8 weeks
Mechanical scarification	8.8	10.6	13.9	13.9
Hot water	8.3	9.7	12.1	12.3
50% Sulphuric acid	-	-	-	-
Control	6.3	7.3	10.9	11.2
Cold water	7.4	8.5	11.8	11.9
F cal = 0.44				
p value = 0.73				
F tab = 3.49				

The statistical analysis on the plant height showed no significant difference between the treatments. Even though, seeds pre-treated with mechanical scarification gave the highest plant height with 13.9cm after week 8 and the least plant height was observed from control (Kishore et al., 2022).

Effect Pre-Treatments on the Stem Girth

Stem girth of the Tamarind was determine also at 2 weeks after the seedling emergence. The result is shown in Table 4.

Table 4: showing the result of the treatments based on the stem girth per 2 weeks interval

Treatments	2 weeks	4 weeks	6 weeks	8 weeks
Mechanical scarification	0.6	0.8	1.3	1.5
Hot water treatment	0.4	0.6	0.9	0.8
50% sulphuric acid	-	-	-	-
Control	0.4	0.7	0.9	0.9
Cold water treatment	0.5	0.7	0.8	0.8
F ca l= 0.67				
p value = 0.59				
F tab = 3.49				

Equally, the statistical analysis showed no significant difference between the treatments, although seeds treated with mechanical scarification have the highest stem diameter (1.5) and seeds treated with hot water and cold water gave the least stem diameter (Reddy et al., 2023).

CONCLUSION

Under natural condition, *Tamarindus indica* takes much time to germinate because of its hard coat, which creates dormancy and slows down germination process. Therefore, the results of the present study demonstrated that *Tamarindus indica* seeds, when treated with mechanical scarification can give better germination execution and growth parameter. As well, pre-treated with hot water can result to germination better than when planted without any

DOI: 10.56892/bima.v7i4.547

tretments, however, sulphuric acids (50% concentration) led to the damage or destroy the viability or fertility of the Tamarind seeds. Therefore, this pre-treatment is very crucial toward breaking seeds dormancy and hastening germination of *Tamarindus indica*. The result obtained could best be used towards improving and replications of Tamarind trees which could be used for food, wood, shed and for local medicine production.

REFERENCES

Abubakar Z. and Muhammad A. (2013). Breaking Seed Dormancy in Tamarind (*Tamarindus Indic*a) A Case Study of Gombe Local Government Area. Journal of Applied Sciences and Environmental Management, 83-87.

Abubakar, Mohammed Shu'aibu, and Muhammad Lawal Attanda (2022). "Factors That Causing Seed Dormancy." In *Seed Biology Updates*. IntechOpen, 2022.

Alabi, O. N., Adikpe, O. A., and Dare, A. H. (2019). Effect of different growing soil media on seed germination and growth of tamarind as influenced by seed dormancy breaking approaches. *International Journal of Environmental Sciences and Natural Resources*, *17*(1), 21-27.

Ayala-Silva, T., Gubbuk, H., and Gordon, G. (2013). Breaking seed coat dormancy with physical and chemical methods in tamarind (Tamarindus indica L.) seeds. *J. Agrie. Univ. PR*, *97*(1-2), 87-96.

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

Boroujerdnia, M., and Hasanzadeh Khankahdani, H. (2021). The effect of different treatments on seed dormancy breaking and early seedling growth of tamarind (Tamarindus indica L.). *Iranian Journal of Seed Science and Technology*, *10*(2), 63-71.

Bello A. G. and Gada Z. Y. (2015) . Germination and Early Growth Assessment of *Tamarindus indica L* in Sokoto State, Nigeria. International Journal of Forestry Research, Article ID 634108, 5 pages.

Ebifa-Othieno, E., Mugisha, A., Nyeko, P., and Kabasa, J. D. (2017). Knowledge, attitudes and practices in tamarind (Tamarindus indica L.) use and conservation in Eastern Uganda. *Journal of ethnobiology and ethnomedicine*, *13*(1), 1-13.

Finch-Savage, W. E., and Leubner-Metzger, G. (2006). Seed dormancy and the control of germination. *New phytologist*, *171*(3), 501-523.

Kishore, K., Kanupriya, C., Samant, D., Acharya, G. C., Singh, H. S., and Sahu, A. (2022). Phenological description and thermal time requirement of tamarind (Tamarindus indica) in tropical conditions. *Annals of Applied Biology*, *181*(3), 309-320.

Macdonald I and Conrad AO (2015). Effect of various pre-treatments on the seedling growth performance of *Tamarindus indica L*. Association of Official Seed Analysts and Society of Commercial Seed Technologists.

Mohammed, S., Samad, A. A., and Rahmat, Z. (2018). Comparison of Embryogenic Callus Induction from Two Malaysian Upland Rice Seed (Cv. Hitam and Wai). *Advanced Science Letters*, *24*(5), 3668-3672.

Mohammed, S., Naziru, A., Mohammed, K., Saidu, H., Muntari, M., and Andrawus, D. (2016). Evaluation of bacteriostatic effect of methanolic extract of guiera senegalensis on some clinical bacteria. *Journal of Advanced*

DOI: 10.56892/bima.v7i4.547

Research in Materials Science, *18*(1), 10-17.

Mozumder S, Khan B and Rahman Md. R (2018). Pre-sowing Treatments for Improved Germination and Growth Performance of *Tamarindus indica L.* in Bangladesh. Asian Journal of Biological Science, 11: 120-129.

Muhammad S. and Amusa NA (2003). Effects of sulphuric acid and hot water treatments on seed germination of tamarind (*Tamarindus indica L*). African Journal of Biotechnology, 2 (9): 276-279.

Ojo, J. A., and Omoloye, A. A. (2021). Abundance and diversity of insects associated with stored grains and tamarind in Nigeria. *Polish Journal of Entomology*, *90*(3), 119-129.

Parameswari, K., Srimathi, P., and Maiarkodi, K. (2001). Standardisation of dormancy breaking treatment in tamarind (Tamarindus indica L.) seeds. *Legume Research-An International Journal*, *24*(1), 60-62.

Patel, M., Tank, R. V., Bhanderi, R. V., Patil, H. M., Patel, V., and Desai, M. (2018). Response of soaking time and chemicals on germination and growth of tamarind (Tamarindus indica L.). *Plant Archives*, *18*(1), 51-56.

Reddy, A., Osman, M., Yadav, S. K., Prasad, T. V., Shankar, K. S., Jyothilakshmi, N., ... and Yadagiri, J. (2023). Performance of Tamarind (Tamarindus indica L.) Accessions under Dryland Conditions. *Legume Research*, *46*(9), 1179-1183.

Saqib, A. I., Ahmed, K., Wakeel, A., Nawaz, M. Q., Qadir, G., Anjum, M. A., ... and Nawaz, M. F. (2023). GROWTH PERORMANCE OF TAMARIND (Tamarindus indica L.) Seedlings to Different Levels of Salinity and Sodicity. *Agricultural Sciences Journal*, *5*(2), 8-18.

Toungos, M. D. (2019). Tamarind (Tamarindus indicus L) Fruit of Potential Value But Underutilized in Nigeria. *International Kournal of Innovative Food, Nutrition and Sustainable Agriculture*, *7*(1), 1-10.

Van der Stege, C., Prehsler, S., Hartl, A., and Vogl, C. R. (2011). Tamarind (Tamarindus indica L.) in the traditional West African diet: not just a famine food. *Fruits*, *66*(3), 171-185.

Vikram, B., Gautam, D. K., Yadav, H. C., Gaurha, A., Kumar, V., Omer, S., and Chawla, R. (2023). Tamarind Cultivation, Value-Added Products and Their Health Benefits: A Review. *International Journal of Plant and Soil Science*, *35*(21), 903-911.