Dormancy and Seed Germination in *Tamarindus indica* (L).

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ABSTRACT

The dormancy and seed germination of *Tamarindus indica* (L) was studied. This involved the usage of some dormancy-releasing methods and the influence of oven dry heat treatments on the seeds. The preliminary germination tests on fresh and air-dried seeds showed low percentage germinability (10-20%). The seeds are known to have high socio-economic value most especially in the savanna regions of the vegetation zones. Subjecting the seeds to conc. nitric acid, hydrochloric acid, and methanol greatly enhanced the percentage germination of the seeds to about 70-100%. The influence of dry heat (40^{o}C and 60^{o}C) treatments on the seeds showed maximum percentage germination of 70-90% within 1-5 hours duration of treatments. This work centered on releasing different methods of improving and inducing germination of the seeds in order to unleash the socio economic importance of the seeds and seedlings. The information gathered in this research will go a long way in eradicating or tackling the problems of dormancy or improve propagative methods of *T. indica* seeds. All these will help the foresters to have access to producing the seedlings to meet the population demands.

(Keywords: *Tamarindus indica*, seed germination, dormancy, nitric acid, hydrochloric acid, methanol)

INTRODUCTION

Seed dormancy is regarded as the failure of an intact viable seed to complete germination under favorable conditions. This could also be known to be as a seed characteristics or the degree of which defines what conditions should be met to make the seed germinate.

Seed dormancy has been the subject of numerous studies. The role of it in revegetation processes has not been adequately investigated most especially in *Tamarindus* seeds. *T. indica* seeds do not germinate when placed under conditions which are normally regarded as favorable for germination could be induced to germinate by various special treatments. However, seed dormancy is not equivalent to the absence of germination.

Germination incorporates those events that commence with the uptake of water by the quiescent dry seed and terminate with the elongation of the embryonic axis (Bewley and Black 1994). The visible sign that germination is complete is usually the penetration of the structure surrounding the embryo by the radicle, the result is often called visible germination. Subsequent events, including the mobilization of the major storage reserves are associated with growth of the seedlings virtually all of the cellular and metabolic events that are known to occur before the completion of germination of non-dormant seeds of *T. indica* may also occur in imbibed dormant seeds.

There are many types of seed dormancy. These include: dormancy imposed by hardness of seed coats or impermeability of tegument; dormancy induced by presence of inhibitors; conditions of light; and dormancy due to embryonic immaturity (Eira 2000). The first and the last dormancy types were found in the seeds of *T. indica*. The germination of dormant seeds of *T. indica* is slower and not uniform as the condition necessary for terminating their dormancy under natural conditions take a long time to achieve.

Despite the fact that many researchers in physiology study dormancy, there is still limited information about the dormancy types and the seed germination of *T. indica* considering the high economic values of these tree seeds. The genus *Tamarindus indica* (L) has only a single species. It was long introduced and adopted in India. The specific name “Indica” perpetuates the

illusion of Indian origin. The tree of the seeds is grown as shade and fruit tree, along road sides, in door yards, parks, and universities campuses. It belongs to the family Leguminoceae and subfamily Ceasalpinaeu (Keay 1989).

Apparently, *T. indica* is associated with various socio-economic benefits, especially in the savanna region. These benefits have made it known as a multipurpose tree species (MPTS). It has been exported in some countries, though it is consumed locally in Nigeria, adding flavor to a local drink called "kunnu" in most parts of the Northern and Southern Nigeria. That is one of the reasons why it is incorporated into the ecological studies and research programs of Forestry Research Institute of Nigeria (FRIN), International Centre for Underutilized Crops (ICUC) among others.

The barks, leaves, fruits, seeds, and roots of the trees are used as pharmaceutical raw materials, food and fodder for livestock. It is useful as cover crops to protect the soil against erosion, excessive evapotransporation, and direct solar radiation. It also serves as energy fuel source, including its biomass which helps in soil nutritional advancement and recycling process. Despite all the aforementioned socio-economic attributes of the plants, there is no proper research to improve its propagative methods because the seeds were found to exhibit dormancy in nature. This has been the major concern of this work: to improve and promote the propagative methods of the seeds in order to make available the seedlings for reforestation and to make available the products of the plants for both local and international demands. Therefore, this work centers on improving the germinability methods of the seedlings by using various treatments that could induce germination and terminate dormancy within the shortest period of time.

MATERIALS AND METHODS

Forest Survey: Several trips were made on different parts of the forest zones and vegetations in Nigeria. The trees of *Tamarindus indica* (L) were found to be predominant in the savanna areas of the forest vegetation of Nigeria. These areas include: Ilorin, Ogbomosho, Sokoto, Adamawa, Kano and Kaduna.

Seed Collection and Processing: The fruits of *T. indica* were collected from the tree stand after the fruit fall within the campus of Bayero University Kano. The fruits were found to have sticky and gummy effects. These fruits were soaked in water overnight. The fleshy fruits were removed and the seeds were extracted and air dried for more than 6 hrs. The damage seeds were sorted from the good ones and discarded. Some seeds were found to be bigger in size than the other ones. Those bigger ones were sorted from the small ones.

The big seeds were tagged "large size seeds", the semi-big ones were tagged "medium size seeds" and the smallest seeds were tagged "small size seeds". All experiments were conducted under laboratory conditions.

Preliminary germination tests: Germination was carried out on freshly harvested seeds using some randomly selected ones according to the methods of (Etejere and Ajibola 1980, Agboola 1996, 1998). About 100 seeds were surface sterilized with 0.1% mercuric chloride solution for 30s and rinsed in several changes of distilled water. They were then placed on moistened filter papers placed in 9cm petri dishes. The set up was maintained at 28-30^{o}C under laboratory conditions. Five set-up were made in this and subsequent experiments.

Dormancy Studies: Seed lots of 100 each were soaked in concentrated nitric acids, hydrochloric acids and methanol for the period ranging from 5-15 minutes. The chemicals were poured on the acids differently in a 500ml beaker and rinsed in several changes of distilled water before placing in Petri dishes that had sterile filter papers in it. A total of 100 seeds from each temperature regime were prepared for germination in the laboratory and untreated seeds served as the control. Mean values for the percentage germination were calculated from germination counts from five replicates. The treatment means were compared using the Analysis of Variance (ANOVA) at $P < 0.05$ and the least significant difference test (LSD^{t}).

Influence of Dry Heat Treatments on the Seeds: The dry seeds were subjected into oven dry heat treatments pre-set to 40^{o}C and 60^{o}C, left for the period of 1-5 hrs. and allowed to stay for 30 mins. after which the seeds were taken out of the oven and allowed to cool at room

temperature in each case before preparing them for germination. Untreated seeds served as control. Seeds were put in 500ml dried beaker before putting in oven for the treatments.

RESULTS AND DISCUSSIONS

The results on the preliminary germination tests on seeds of *T. indica* showed low percentage germination (Table1).

Table 1: Preliminary Germination Trial

Days of Germination	Percentage Germination (%)	
1	0.0[c]	0.0±0.0
2	10.0[b]	10±0.0
3	10.0[b]	10 ±0.0
4	10.0[b]	10.±0.1
5	20.0[a]	20±0.0
6	20.0[a]	20±0.0

Data are means of five replicates

Preliminary germination tests showed a very low percentage germination of *T. indica* seeds. The seeds exhibit dormancy and required pretreatment for best germinating resultS. Etejere and Ajibola (1990) and Agboola (1998) also observed such situations in seeds of *Parkia biglobossa, Prosopis africana, and Albizia lebbeck*, some of which are forest tree seed species of the savanna zone.

Seed pretreatments such as sulfuric acid abolished dormancy in their seeds. The pretreatments that terminated dormancy in seeds of *T. indica* in this study (i.e., the combination of nitric acid, hydrochloric acids, methanol, and dry heat treatments) showed that the seeds suffer from physiological and physical dormancy. This is also true of seeds of *Prickly* sida, *Dialium guineensis* (Baskin and Baskin 1984, Ajiboye et al., 2006) and *Centrosema pubescens* (Omokanye and Onifade 1993).

Forest tree seeds are subject to dormancy of many kinds causing delay in germination of variable duration. These are to be ecological advantage of the establishment of the trees in their habitat (Kolk 1979). Dry heat treatments on the *T. indica* seeds helped to cause some metabolic changes within the dormant seeds. This is similar to the findings of (Agboola 2005) which discovered that heat treatment in the case of *Tithonia diversifolia* seeds helped to cause some metabolic changes within the dormant seeds. The ability of the embryo to germinate appears only when seeds have undergone warm stratification (Nikolaeva 1980, Esenewo and Adebona 1990).

Dry and wet heat treatments also reduce dormancy in the forest tree seeds. There have been various instances where high temperature treatments have been used to terminate dormancy (Ajiboye, 2006). High temperature may cause changes in the structure of the seed coat thereby causing permeability of seeds to water and gases and enhance germination (Fasidi 2000). Some stages of germination have been found by the physiologist to precede seedling emergence which include mobilization of food reserves in the endosperm or cotyledons after inhibition of water, resumption of growth by the embryo and consequent development and emergence of radicle (Ajiboye 2006).

Each of these stages required metabolic energy produced during the metabolic processes involved in the oxidation of carbohydrates, protein and fats (Agboola 2003). The outcomes of this work have revealed some of the methods that could be used to combat the problems of the seedlings of the trees for commercialization. If the foresters can adopt most of the methods in this study, the problems of raising seedlings from the seeds for commercial purpose would be a thing of the past so that afforestation could be easily embraced.

The preliminary germination tests showed that the seeds cannot germinate easily. There was small evidence of germination between the untreated seeds and the control. They showed 10-20% germination. However, the results showed that the seeds can germinate after subjecting them into various dormancy releasing treatments. The percentage germination of the seeds after Nitric acid treatments showed about 80-90% germination after treating the seeds for 10mins especially the small size seeds while 20% germination was observed under 15mins treatments (Figure 1).

Figure 2 showed that up to 50% percentage germination was observed when subjecting the medium size seeds to about 10mins treatments. About 20-30% percentage germination was found to occur under 15mins treatments.

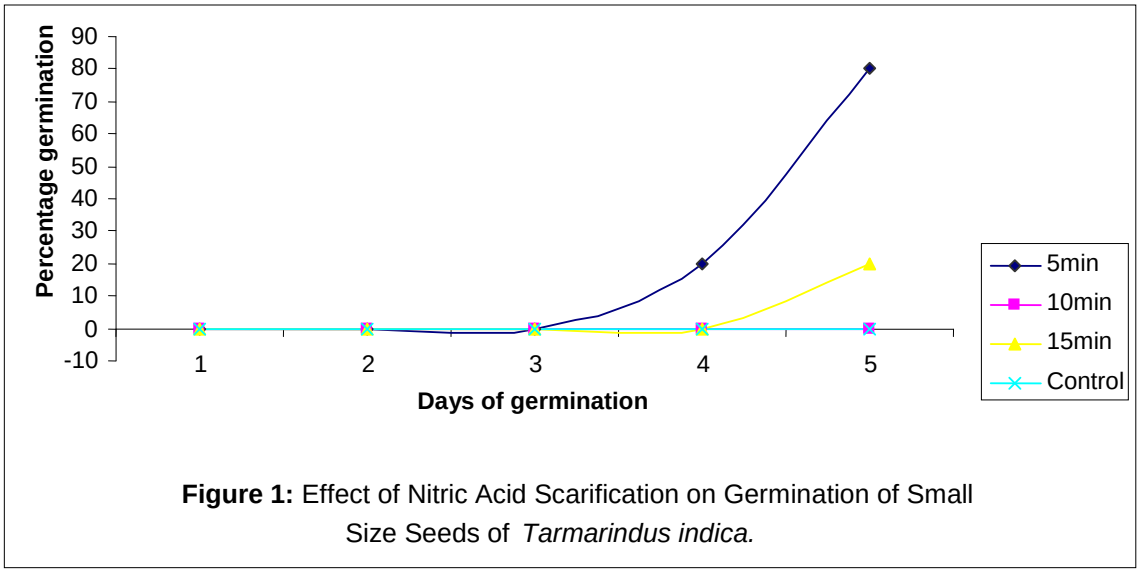

Figure 1: Effect of Nitric Acid Scarification on Germination of Small Size Seeds of *Tarmarindus indica.*

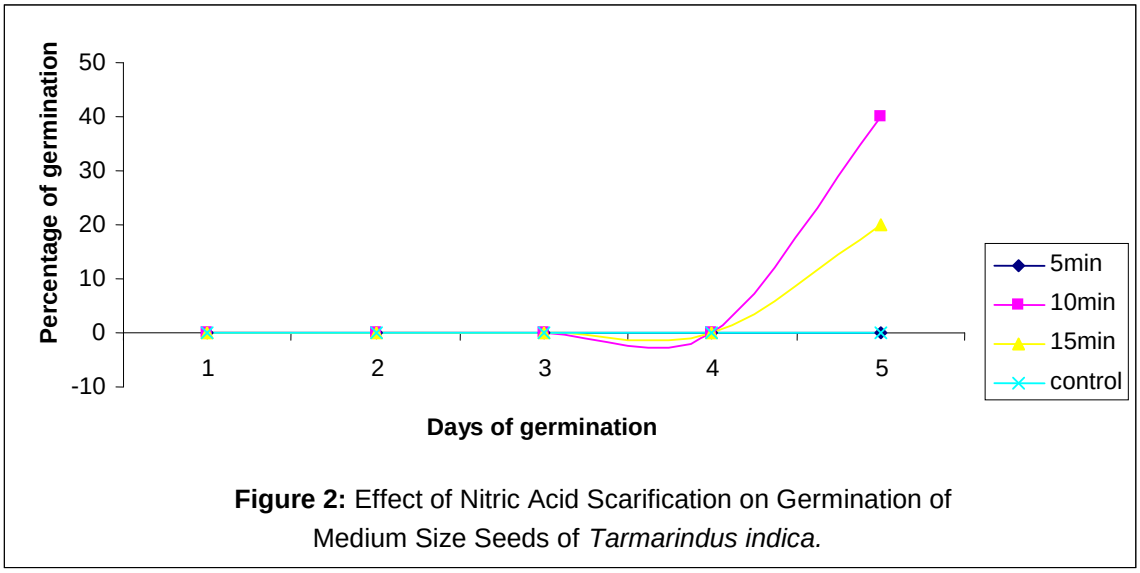

Figure 2: Effect of Nitric Acid Scarification on Germination of Medium Size Seeds of *Tarmarindus indica.*

In the large size seeds of *T. indica* subjected into Nitric acid scarification showed as low as 20-25% percentage germination under 10mins treatments (Figure 3). However, Figure 4 showed 70% percentage of germination under 5 min treatments of Hydrochloric acids especially on small size seeds whereas, Figure 5 showed a low percentage germination of 20-25% for seeds treated with conc. hydrochloric acid under 10mins within 3-5 days of sowing.

The large size seeds showed high percentage of 70-100% germination. There was high percentage of seed germination of *T. indica* seeds after the treatments with methanol soaked under 5-15 mins. The percentage germination 80-90% was observed under 10-15 mins. treatments while about 60-70% germination was observed under 10 mins. treatments within 3-4 days of sowing (Figure 5).

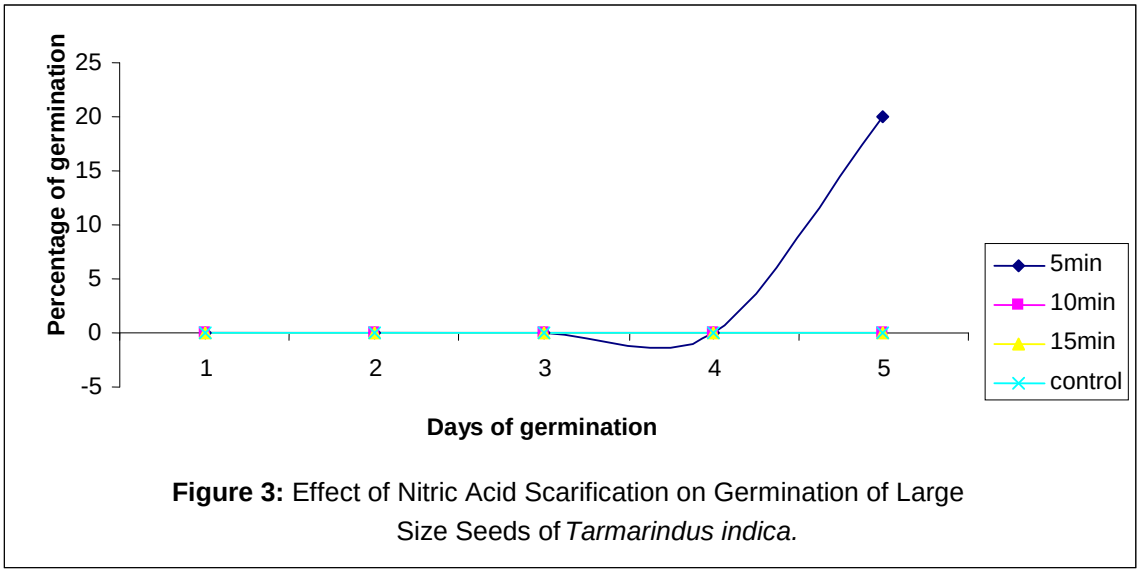

Figure 3: Effect of Nitric Acid Scarification on Germination of Large Size Seeds of *Tarmarindus indica.*

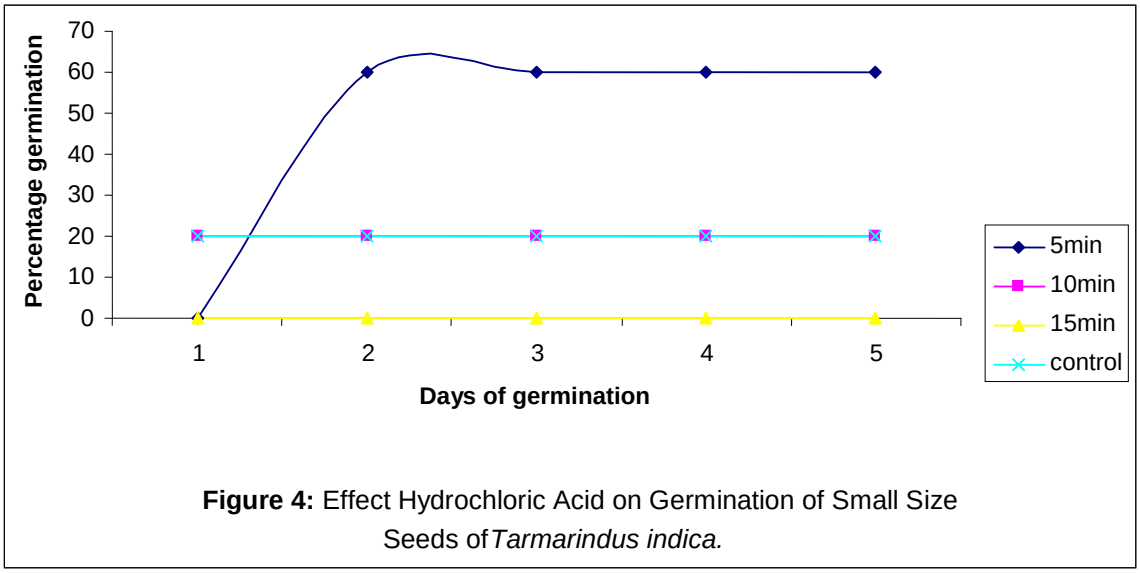

Figure 4: Effect Hydrochloric Acid on Germination of Small Size Seeds of *Tarmarindus indica.*

However, about 40-50% percentage germination was observed under 5mins treatments witin 4-6 days of sowing. Whereas, only 10-20% germination was observed for the control (Figure 6).

Figures 7 and 8 sowed the influence of dry heat treatments on seed germination of *T. indica* seeds. It was observed that at 3 hours treatments under 40^{o}C the percentage germination was maximum being 80-90% within 4-5 days of sowing (Figure 7) while the lowest germination showed in 1-2 hours treatments (Figure 7). Under (60^{o}C) dry heat treatments, 5 hours duration of treatment showed 60-70% germination within 5-8 days of sowing, Followed by the 1 hour duration treatment which showed about 50% percentage germination (Figure 8).

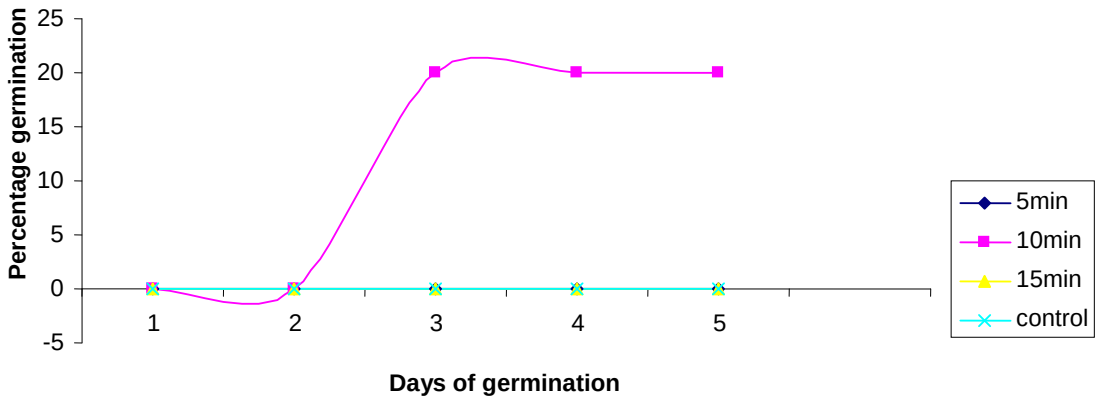

Figure 5: Effect of Hydrochloric Acid on Germination of Medium Size Seeds of *Tarmarindus indica.*

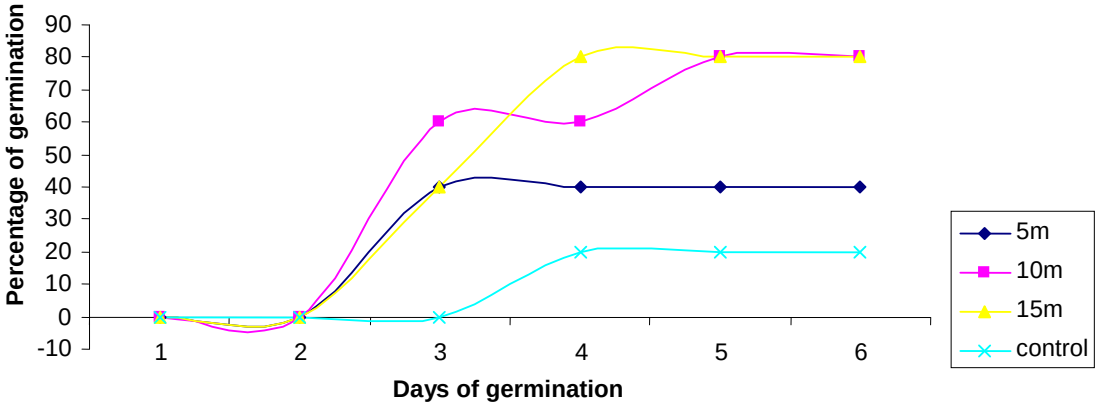

Figure 6: Effect of Methanol Scarification on Germination of Seed of *Tarmarindus indica.*

Therefore, the usage of nitric acid, hydrochloric acid, methanol and oven dry heat treatments can terminate effectively the dormancy problems of this valuable socio-economic seeds.

Moreover the above treatments are hereby recommended for farmers and foresters to raise more seedlings of this species for afforestation and ornamentation of the environment.

CONCLUSION

The research will help in promoting the propagative culture of this seeds which may in turn assist in the establishment of seedlings for afforestation programs to combat the problem of global warming.

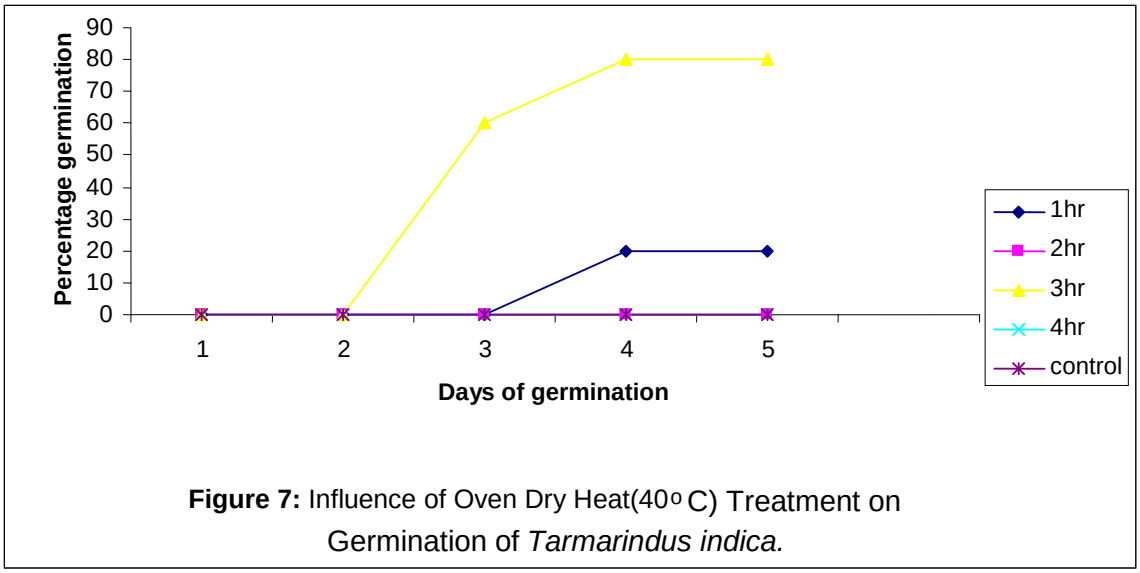

Figure 7: Influence of Oven Dry Heat(40^{o}C) Treatment on Germination of *Tarmarindus indica.*

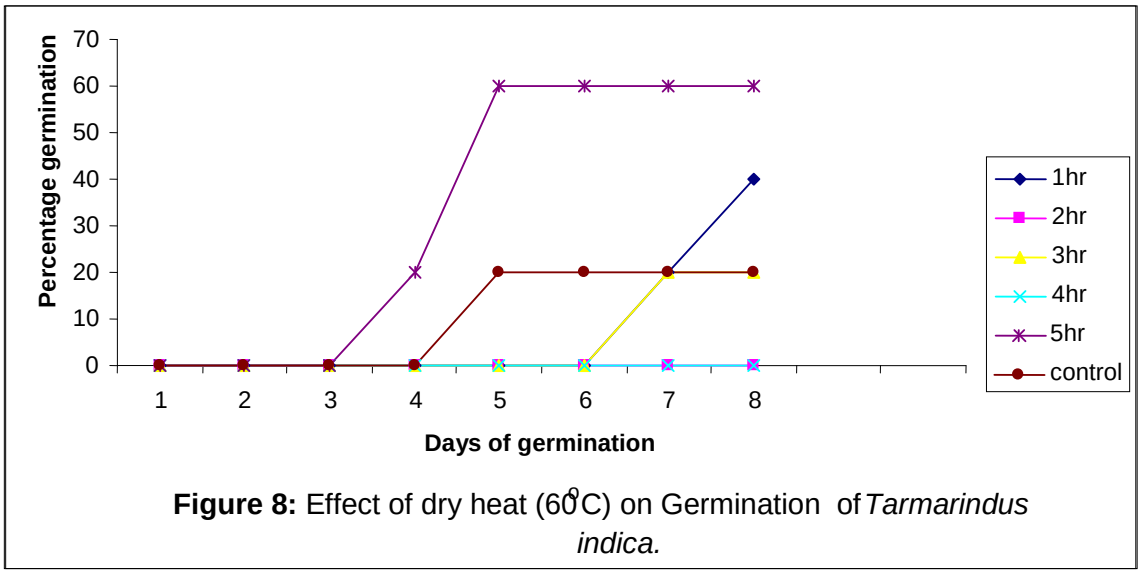

Figure 8: Effect of dry heat (60^{o}C) on Germination of *Tarmarindus indica.*

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