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Evaluation of the Effect of Pre-Germination Treatment on *Delonix regia* Seeds

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Abstract

Delonix regia (Flamboyant) is a multipurpose tree species indigenous to semi-arid regions of Sub-Saharan Africa. It is being exploited to local extinction due to high dependence for fuel wood and other uses. The present study explored different pre-treatment methods for enhancing seed germination and growth of *Delonix regia* (Flamboyant) in Taraba State, Northern Nigeria. The experiment employed a 4 × 4 factorial design with seeds subjected to four pre-treatments (50% sulphuric acid concentration, 98% sulphuric acid concentration, cold water and hot water) at four pre-treatment time durations. Number of germination and plant height varied significantly between pre-treatments with cold water treatment recording the highest plant height (3.5cm) and the 98% sulphuric acid concentration recording the least (1.3cm). Germination rate had a moderate positive relationship with plant height. The study recommends seed immersion in cold water for 48 h as the most efficient pre-treatment for *Delonix regia* (Flamboyant).

Keywords: *Delonix regia*, Sulphuric acid, Germination, Cold, Hot

INTRODUCTION

Pre-treatment or pre-germination treatment is a term for conditions or process applied to break dormancy before germination (Bewley and Black, 1994; Costa *et al*., 2010). In many species, seed dormancy can be broken by treatment directed towards altering or increasing the permeability of seed coats or reducing their mechanical resistance to embryo growth, the degree and kind of dormancy.

In some species, seed dormancy can be easily broken by any of several treatments, whereas seed of other species responds only to a single, specific treatment. Seed dormancy of certain species sometimes cannot be broken by any of the methods commonly used (Bolognez *et al*., 2015). Seed which have not been given an appropriate treatment to overcome dormancy may fail to germinate altogether, germination may be slow or germination of individuals' seed in a seed lot may take place over a lengthy period (Bewley and Black, 1994; Costa *et al*., 2010).

The purpose of pre-treatment is to ensure that seed will germinate, and that germination is fast and uniform according to Bewley and Black, (1994). Treatment method have been developed and described for many species, yet dormancy still cause problem of seed germination partly because of lack of knowledge of their seed physiology, partly because of variation in dormancy rate.

This study examines the effect of pre-germination treatment of *Delonix regia* (Flamboyant) seeds.

MATERIAL AND METHODS

Study area

The experiment will be conducted at the college nursery of the Department of forestry, College of agriculture, Jalingo, Taraba State. It lies between latitude 8° 30' N to 9° 0' N and longitude 11° 0' E to 11° 30' E (Figure 5). The area records a monomodal rainfall pattern with a mean annual rainy days set at 147.19. Average annual temperature is 29.7°C. The vegetation is dominantly grassland interspersed with indigenous and exotic tree species such as *Parkia biglobosa* (dawadawa), *Vitellaria paradoxa* (shea), *Lannea acida* (lanea), *Azardirachta indica* (neem), *Magnifera indica* (mango*)*, *Tectona grandis* (teak), *Senna siamea* (cassia).

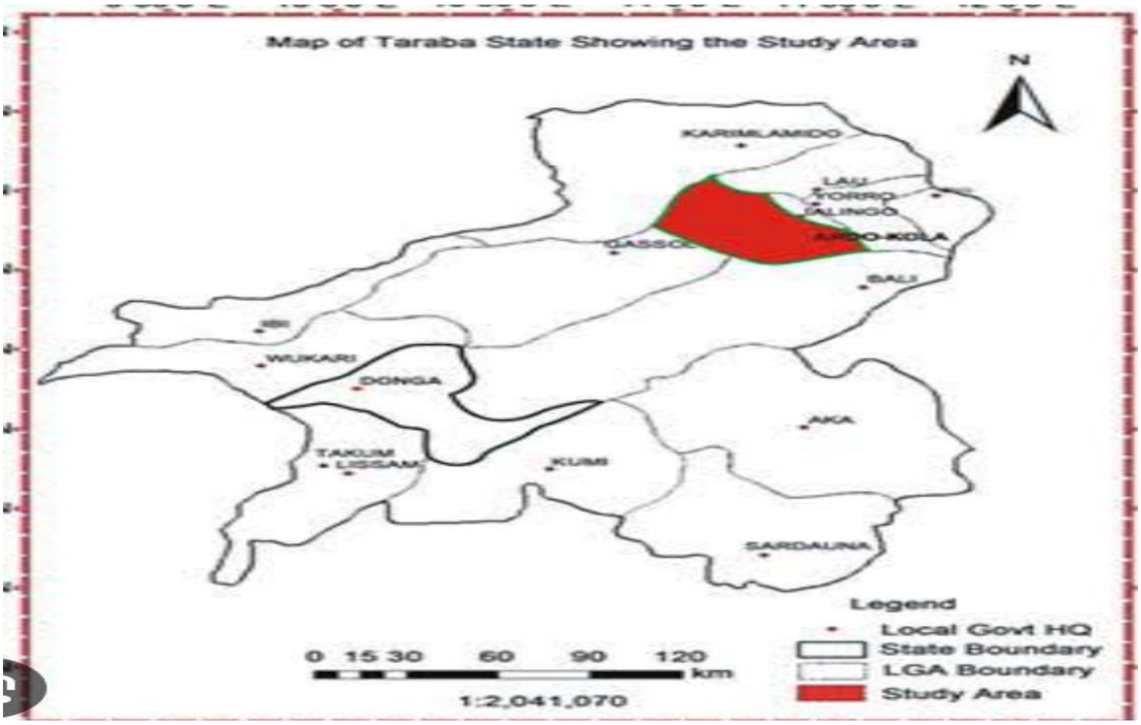

Figure 1: Showing the study area

Seed collection and viability test

Seeds of *D. regia* were collected from the department of forestry, college of agriculture, Jalingo, Taraba State. Seeds were sorted to eliminate diseased and bruised seeds. The seeds will then be subjected to pre-treatment. Prior to the germination experiment, 180 seeds were sampled for a seed viability test using floating test.

Experimental design

Seeds will be subjected to four pre-treatment methods at four pre-treatment time durations with the untreated seeds as control. The pre-treatment methods were;

(i) Seeds soaked in 98% sulphuric acid concentration for 1, 5, 10 and 15 min

(ii) Seeds soaked in 50% sulphuric acid concentration for 1, 5, 10 and 15 min

(iii) Seeds soaked in cold water for 12, 24, 36, and 48 h

(iv) Seeds soaked in boiled water (100°C) for 12, 24, 36, and 48 h

(v) Control (untreated seeds)

Each treatment combination had 20 seeds, making a total of 100 seeds for the experiment. The pre-treated seeds will be sown in seed boxes half filled with topsoil. The seed boxes were arranged in a Completely Randomized Design with 3 seeds per box. Each treatment combination was replicated in three seed boxes. Seed boxes were watered twice daily with 1500 ml of water per box. Weeds were controlled by hand to prevent competition as describe by Bernard *et al.*, (2019) with slight modification.

Data collection

Data will be collected on seed emergence, plant height, and root length. Number of seeds emerged was recorded daily per seed box from the day of first germination to the end of the germination period (4th week after sowing). Growth parameters were recorded once every two weeks from the 4th week after sowing to the 10th week after sowing. Seedlings were uprooted after the tenth week for root length measurement. Plant height and root length will be measured using a measuring tape.

RESULTS

Results of seed germination pre-treated with Seeds soaked in 50% sulphuric acid concentration for 1, 5, 10 and 15 min

Table 1: Effects of pre-treated seeds with 50% sulphuric acid at different time on seed germination

Pre-treatment	Time (min)	No. of germination	Days of emergence	Plant height (cm)	Root Length (cm)
50% sulphuric acid	1	2	10	2.9	2.4
	5	4	11	2.1	1.8
	10	3	11	1.8	1.5
	15	2	12	2.2	2.1
Untreated seeds (control)	Nil	3	11	1.8	2.6

Results of seed germination pre-treated with Seeds soaked in 98% sulphuric acid concentration for 1, 5, 10 and 15 min

Table 2: Effects of pre-treated seeds with 98% sulphuric acid at different time on seed germination

Pre-treatment	Time (min)	No. of germination	Days of emergence	Plant height (cm)	Root Length (cm)
98% sulphuric acid	1	2	11	1.6	1.6
	5	3	12	2.1	1.8
	10	2	14	1.6	1.2
	15	1	13	1.3	1.7
Untreated seeds (control)	Nil	3	11	2.8	2.6

Results of seed germination pre-treated with Seeds soaked in cold water for 12, 24, 36 and 48 h

Table 3: Effects of pre-treated seeds with cold water at different time on seed germination

Pre-treatment	Time (h)	No. of germination	Days of emergence	Plant height (cm)	Root Length (cm)
Cold water	12	3	10	3.2	2.1
	24	4	11	1.9	1.7
	36	3	10	2.4	2.3
	48	5	8	3.5	2.7
Untreated seeds (control)	Nil	3	11	2.8	2.6

Results of seed germination pre-treated with Seeds soaked in hot water for 12, 24, 36 and 48 h

Table 4: Effects of pre-treated seeds with hot water at different time on seed germination

Pre-treatment	Time (h)	No. of germination	Days of emergence	Plant height (cm)	Root Length (cm)
Hot water	12	3	11	2.6	1.8
	24	2	11	2.3	1.6
	36	3	11	2.7	1.4
	48	2	9	3.0	1.9
Untreated seed (control)	Nil	3	11	2.8	2.6

DISCUSSION

Rate of germination varied significantly between pre-treatment methods with cold water treatment recording the least emergence days of seedlings (Day 8) at seed soaked for 48 h, while seed soaked in 98% sulphuric acid recorded the highest emergence days of seedling (Day 13) at seed soaked for 15 min. The cold water treatment recording the highest percentage as well as shortest time to first seed emergence could be attributed to the ability of cold water to enhance seed coat permeability. This enabled gaseous exchange and enzymatic hydrolysis to transform the embryo into a seedling without negatively affecting the functional organs of the seed (Olatunji *et al*., 2013). This also agrees with Azad et al. (2011) who identified water as a necessary requirement for seed germination. *D. regia* has a hard seed coat which needs to be ruptured before radicle and plumule emergence. Hence seeds that were immersed in cold water for a longer period (48 h) had an early seed coat rupture and permeability which facilitated a faster rate of emergence. This could explain the significantly higher percentage germination and early days to emergence recorded among seeds that were immersed in cold water for 48 h. This phenomenon confirms earlier reports by Missanjo *et al*. (2013) and Mwase and Mvula (2011), who reported seed coat permeability as one of the determinants of seed germination.

The relatively low number of seeds germination in 98% sulphuric acid as compared to control (Table 2) seem to suggest detrimental effect of this chemical to *D. regia* seeds at higher concentrations. This is in accordance with Asl *et al.* (2011), that sulphuric acid has a detrimental effect on seed embryo. This could be attributed to the fact that some enzymes have specific pH ranges; therefore higher acid concentration above this range tends to provide unfavourable pH conditions for normal enzymatic activity. However, at low concentrations, sulphuric acid could have a positive effect on seed germination; this was evident in the fact that 50% sulphuric acids had higher percentage germination than the control treatment (Table 1 and 2).

Hot water pre-treatment resulted in a low number of germination as compared to the cold water treatment probably due to the high temperature the seeds were exposed to. This argument is supported by the findings of Singh *et al.* (2019) who indicated that hot water may tend to be detrimental to enzymatic activities at higher temperatures when used as pre-treatment.

The control treatment were found to record lower number of seeds germination as compared to some pre-treatments (Cold water, 50% sulphuric acid and hot water) which could be an indication of some level of dormancy in *D. regia*. This suggests that pre-treatments have positive influence on germination of *D. regia* which could be a positive signal to nursery managers and foresters for the domestication of the species.

A significant increase in the growth of plant shoot and root was observed in pre-treated seeds with cold water when compared to the 98% sulphuric acid. The highest plant height was observed at seeds pre-treated with cold water soaked for 48 h, while the least plant height was observed at pre-treated seeds soaked in 98% sulphuric acid for 15 min. The root length was observed to show the highest in seedlings pre-treated in cold water for 48 h and least in seedlings soaked in 98% sulphuric acid for 10 min.

CONCLUSION

The study concludes that both pre-treatment method and duration of treatment have significant effects on the germination and growth performance of *D. regia*. Soaking *D. regia* seeds in cold water for 48 h could be recommended for large scale production of seedlings as it resulted into almost 100% seeds germination. Although acid treatment can equally enhance germination, higher acid concentration could result in detrimental effects.

Similarly, cold water treatment resulted in an early germination of *D. regia* seed as compared to hot water pre-treatments. Significant effect of pre-treatment on germination translated into a positive effect on seedlings plant height and root length all positively correlated with germination.

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