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# Effect of Pretreatments on Germination and Growth of *Berlinia grandiflora* (Caesalpiniaceae) (Vahl) Hutch. & Dalz

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## Abstract

*Berlinia grandiflora is an agroforestry species of socio-economic interest in the Adamawa region of Cameroon. Seeds of this species are traded internationally between Cameroon and Nigeria. Regeneration of this species by seed is rare in its natural environment. The objective of the study was to apply pretreatments to seeds in order to study the germination and growth of B. grandiflora plants in nursery. The work consisted in applying five pre-treatments to the seeds which are manual scarification, soaking in tap water for 12 hours, soaking in boiling water without a heat source for 2 minutes, soaking in sulfuric acid for 10 minutes and control. The experimental design was a complete randomized block with four repetitions and the experimental unit consisted of 42 seeds. Germination and morphological aspects of seedling growth were monitored for 70 days. Germination time was 5 days. The germination rate varies from 80.35% for scarified seeds to 32.14% for seeds soaked in boiling water for 2 minutes. The analysis of variance shows a difference between the different pretreatments (0.0006 < 0.001). Concerning the growth parameters, the height of the seedlings varies from 14.07±1.98cm in seedlings grown from seeds soaked in tap water for 12 hours to 10.95±1.08 cm in seedlings grown from seeds soaked in boiling water without a heat source for 2 minutes. The analysis of variance of the heights of the plants from the different pre-treatments shows a significant difference (0.02<0.05). This study aims to better understand the germination and growth characteristics of this species in order to ensure its sustainability.*

**Keywords**: *Berlinia grandiflora*, germination, growth parameters, pretreatment.

## Introduction

Clear forests provide many animal and plant resources that are sources of food, medicine, fuel wood and timber for local population[1]. In recent decades, the intensification of human pressure on the forest and bush fires have created conditions conducive to degradation, deforestation and desertification[2]. This deforestation and degradation cause damage that goes far beyond the loss of biodiversity, products and environmental services that forests and trees provide like carbon sequestration, soil stabilization, adaptation to the destructive effects of global warming[3]. Many species provide non-timber forest products (NTFPs) and contribute to the fight against poverty. They still live in the wild and are overexploited in their natural ecosystem. *Berlinia grandiflora* is a medium-sized tree reaching 25-30m in height; the bole is often short, often irregular, sometimes straight and cylindrical, reaching 50-70cm in diameter, without buttresses. Bark surface scaly, dark gray to brown, inner bark pale brown to reddish brown, sometimes secreting a yellowish resin.

The crown is rounded, dense, with spreading branches; twigs brown, glabrous. The leaves are alternate, compound paripinnate with 2 or 3 pairs of leaflets with large caducous stipules and a petiole 2 to 4 or 5cm long. The petiolule is stocky, 0.5-1cm long. The leaflets are opposite or nearly so, oblong-elliptical to ovate, asymmetrical 7–22cm×3–11.5cm. The fruit is a large, woody, oblong, flattened pod up to 30cm×7cm, short-stiped, short-hairy and densely golden, yellowish-brown to brown, indistinctly diagonally veined, dehiscing with 2 valves to about 4 seeds. The seeds are flat, rounded to ellipsoid, up to 4 cm in diameter and dark brown[4].

*Berlinia grandiflora* is among the most socio-economic important tree species in the high Guinean High Savannahs of Adamawa[5]. The seeds of this species are traded internationally in this region. These seeds are sought by Nigerian traders who travel through the villages of Adamawa-Cameroon to collect them[6]. They are eaten as beans, and are transformed into paws and prepared as a sauce.

To overcome the phenomenon of overexploitation of the seeds, the domestication of this species of socio-economic interest in order to introduce it into farmers' production systems is a solution to consider; hence the objective of this work is to evaluate the effect of pre-treatment on the germination and growth of this species.

## Materials and Methods

**Study area:** The study was conducted in the nursery of the Biodiversity and Sustainable Development Laboratory of the University of Ngaoundéré (Altitude 1079m; Longitude 13°32'E; Latitude 7°24'N). The climate is of the Sudano-Guinean type with two seasons including the rainy season from April to October and a dry season from November to March[7]. The average rainfall was 228.14 mm/month. The average relative humidity was 80.44%, the average temperature was 28.24°C. The area is covered with shrub and/or woody savannah dominated by *Daniellia oliveri* and *Lophira lanceolata*[8]. The evolution of the vegetation is severely hampered by anthropic activities[9].

**Seed collection:** The seeds used for our tests are seeds (Figure-1) collected in the Guinean high Savannahs of Mbé under *Berlinia grandifolia* adult trees (Altitude 1081m, Longitude 13°33'130'E, Latitude 7°25'127'N).

**Pre-germination treatments:** A total of 840 seeds of *B. grandiflora* were subjected to five pre-germination treatments: one batch of seeds served as a control (the seeds had not undergone any pretreatment), one batch was scarified manually with using a saw, one batch was soaked in sulfuric acid for 10 minutes, one batch was soaked in boiling water at 100°C without a heat source for 2 minutes and another batch was soaked in tap water for 12 hours before sowing in pots. This approach was inspired by the work of Mapongmetsem et al.[10], Likoswe et al.[11] and Ahoton et al.[12].

## Methodology

**Experimental design:** The experimental design used is a completely randomized block with 4 replications. The experimental unit was 42 seeds per pretreatment. So the number of seeds used is: 42x5x4=840 seeds.

Data collection was carried out every 2 days for 70 days from the germination of the first seed. The following parameters were determined: germination times, germination rate (T=G/N with T=germination rate, G=number of seeds germinated and N=number of seeds by treatment), growth parameters (height, number of leaves). The percentages, mean values and standard deviations of the parameters studied were calculated.

**Analysis of collected data:** Statistical analyzes focused on variance. The separation of significant means was done using the Duncan Multiple Range Test. The statistical program used was Statgraphics plus 5.0. The graphs were produced using the Microsoft Office Excel.

## Results and Discussion

The mode of germination of *B. grandiflora* is characterized by emergence of the collar and cotyledons above the ground. It is epigeal germination (Figure-2).

**Impact of treatments on the germination rate:** The results obtained with regard to the evolution of the germination rate of the batches of seeds having undergone different compared treatments are presented in Figure-3. Germination time varies from 2 days for seeds soaked in tap water to 6 days for seeds soaked in boiling water for 2 minutes. The first to germinate were observed in seeds soaked in tap water and then followed by manually scarified seeds. The evolution of the germination rate is increasing until the twenty-second day and then stabilizes to form a saturation plateau for all the pretreatments applied to the seeds. Manual scarification has the highest germination rate (80.35%) followed by control (78.57%) and tap water (76.78 %). On the other hand, the low germination rate is recorded in seeds soaked in boiling water for 2 minutes (32.14%). The analysis of variance shows a significant difference ($0.0001< 0.001$).

**Growth parameters: Average seedling height:** After 70 days of observation, the average height of the plants varies from 10.95±1.08 cm in plants grown from seeds soaked in boiling water to 14.07±1.98 cm in plants grown from seeds soaked in tap water (Figure-4). Plants grown from seeds soaked in sulfuric acid for 10 minutes and manually scarified showed 11.17±1.42 cm and 12.92±0.96 cm respectively. The highest average height was recorded in seeds soaked in tap water for 12 h. On the other hand, low heights are observed in plants grown from seeds soaked in boiling water for 2 minutes. The analysis of variance shows a significant difference ($0.02<0.05$) between the plants from different pretreatments.

**Number of seedling leaves:** The number of seedling leaves varies from 4±0.57 in control plants to 5±0.83 in those from seeds soaked in tap water for 12 hours (Figure-5). The other pretreatments showed the same number of leaves. However, seedlings from seeds soaked in tap water for 12 h recorded high leaf counts. There is no significant difference ($0.35>0.05$) for the mean number of seedling leaves.

**Discussion:** The different germination rates observed on the curves show that manual scarification has the highest rate with 80.35%. Manual scarification using a saw leads had permitted the rapid imbibition of the seeds and promotes the entry of water into the reserves. This process induces root growth and the triggering of metabolic reactions in the embryo and cotyledons. This phenomenon will accelerate germination but this method exposes the embryo and the cotyledons to excessive ingress of water and protein, and parasitic attacks[12]. This would explain the non-germination of all the seeds in this pre-treatment[12]. The batch of seeds that have not undergone any pretreatment has a rate of 78.57% which is above that of soaking in tap water for 12 hours (76.78%), soaking in sulfuric acid 98% concentrate for 10 minutes (64.88%) and soaking in boiling water for 2 minutes. Indeed, most of the seeds embryos would be destroyed by the long duration of the seed soaking time. Soaking seeds in tap water, boiling water and concentrated sulfuric acid weaken the tegument which stimulates seed

germination. The different pre-treatments reduced the seed germination time. The germination rates obtained in this study are comparable or even higher than those obtained by Likoswe et al.[11] on the germination of *Terminalia serica* where they obtained a germination rate of 0% when these seeds are soaked in sulfuric acid for 3 to 4 hours and 14% when they are soaked for 2 hours. The author gets a 12% result by soaking these seeds in cold water for 24 hours. Higher germination rates are obtained with *Prosopis africana*[12]. The authors obtain a result varying from 57 to 70% by carrying out a manual scarification of the seeds of *Prosopis africana*. Germination rates more or less similar to ours are obtained with the seeds of other species which have undergone soaking in boiling water, soaking in tap water, soaking in sulfuric acid. It is the case of *Piliostigma reticulatum* at 19%[13]; *Alstonia boonei* (82.6%), *Cordia platythyrsa* (68.5%), *Terminalia superba* (100%), *Pynacthus angolensis* (100%)[10].

The different pretreatments influenced the growth parameters of *B. grandiflora*. The highest average height and the average number of leaves are recorded in seedlings from seeds soaked in tap water for 12 hours with respectively 14.07±1.98cm and 5± 0.83. On the other hand the low height is observed in seedlings from seeds soaked in boiling water for 2 min (10.95±1.05cm). This growth is due to the fact that the seeds have absorbed a quantity of water which has allowed the nutrient reserves stored in the cotyledons to cause the activation of auxin which ensures the growth of the stems of the seedlings[14]. Furthermore, Silue et al.[15] on *Khaya senegalensis*, Boyombe et al.[16] on *Entandrophragma cylindricum*, *Petersianthus macrocarpum* and *Uapaca guineensis*, Silue et al.[17] on *Isoberlinia doka* and *I. tomentosa* showed lower growth parameters values than *B. grandiflora*. However, the work of Benmahioul et al.[18] on *Pistacia vera* showed growth parameters superior to those obtained in *B. grandiflora*. Ali et al.[19] on *Diospyros mespilliformis* obtained an average height of 11.84cm and an average number of leaves of 8. The test carried out on *Detarium senegalensis* after 8 months revealed a height of 137.33±7 08 cm and a number of 12 leaves[20].

**Figure-1:** Seeds of *Berlinia grandiflora.*

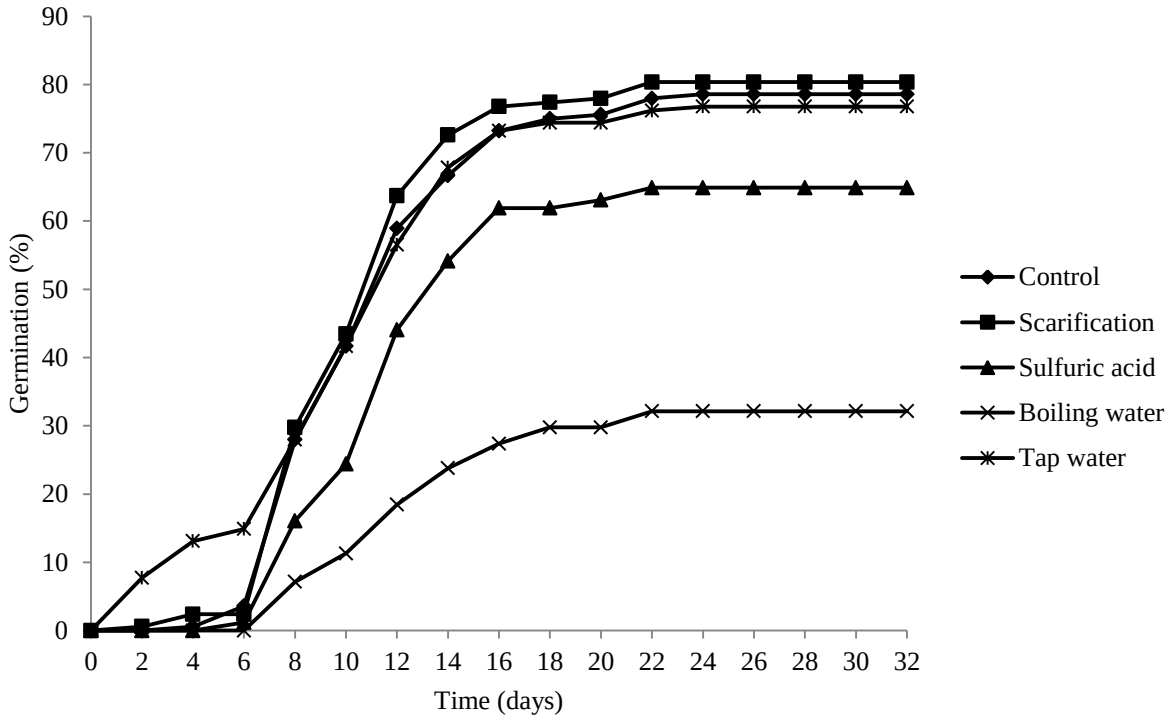


**Figure-2:** Seedling of *Berlinia grandiflora.*

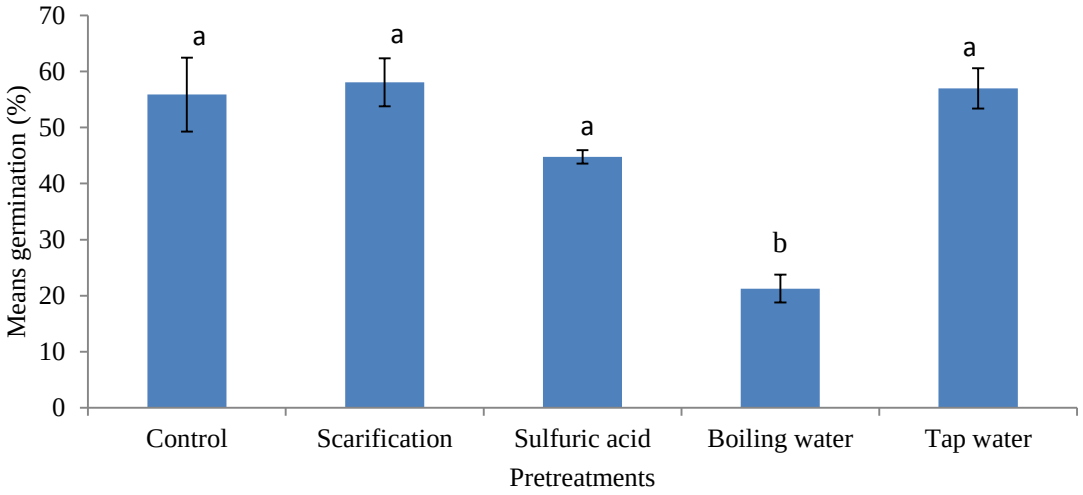


**Figure-3:** Germination rate according the treatments.

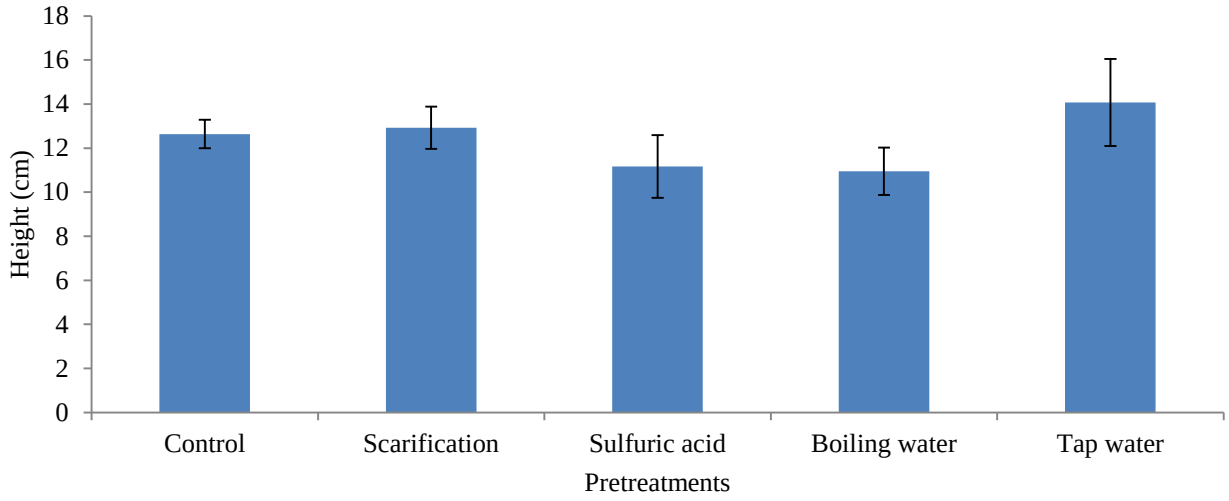


**Figure-4:** Average height of plants according to pre-treatments.

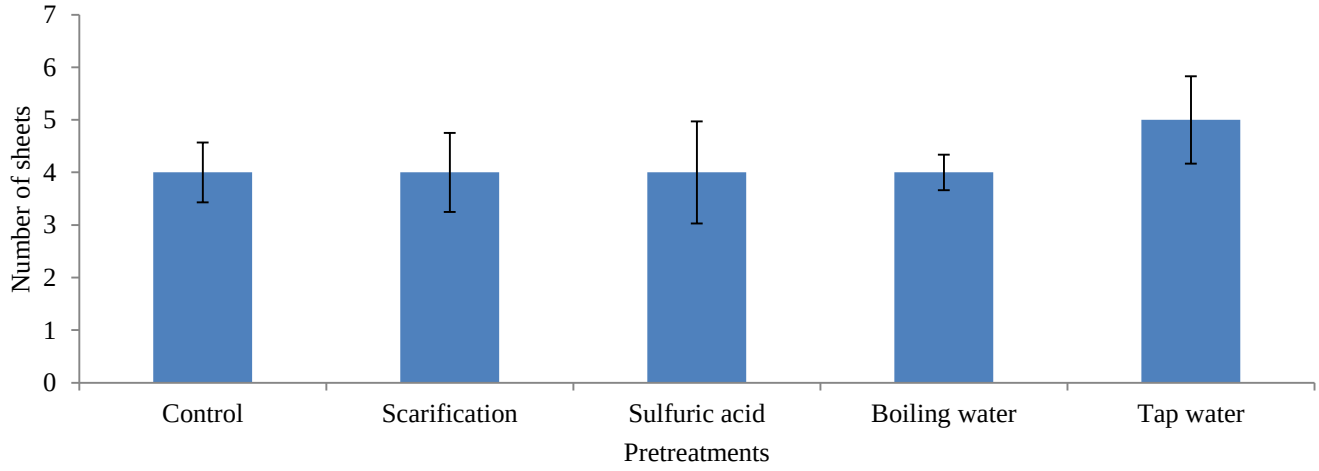


**Figure-5:** Number of leaves according to pretreatments.

## Conclusion

At the end of this study, which focused on the germination and growth of *B. grandiflora*, the average germination rate was 66.54%. Manual scarification presented the best germination rate with 80.35%. Seedlings from seeds soaked in tap water for 12 hours showed the highest growth parameters. It would be important to explore other modes of propagation, in particular those of cuttings, layering and grafting to obtain quality plant material in the short term.

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