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Effects of three pretreatments on seed germination and seedling growth of *Mansonia altissima* (A. Chev.) in a nursery, a timber species exploited in Cote d'Ivoire

Golou Gizèle ZANH [1,*], Lisette Zeh TOKPA [2], Claude Bernard AKE [1] and Yao Sadaiou Sabas BARIMA [3]

[1] *Laboratory of Biodiversity and Tropical Ecology, Environmental Training and Research Unit, Jean Lorougnon Guédé University, BP 150, Daloa, Cote d'Ivoire.*
[2] *Laboratory for Improvement of Agricultural Production, Training and Research Unit in Agroforestry, Jean Lorougnon Guédé University, BP 150 Daloa, Cote d'Ivoire.*
[3] *Laboratory of Tropical Biodiversity and Ecology, Environmental Training and Research Unit, Jean Lorougnon Guédé University, BP 150, Daloa, Cote d'Ivoire.*

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Abstract

Côte d'Ivoire's forests are a reservoir of biodiversity. Indeed, they offer a diverse ecosystem service. However, they are subject to strong anthropogenic pressures, which have resulted in the disappearance of several plant species. This was the case of *Mansonia altissima*, a species renowned for the quality of its wood. Given the importance of this species, there is an urgent need to focus on its conservation. It is in this context that this study aims to improve seed multiplication and the growth of M. altissima seedlings with a view to using them in reforestation. To achieve this, three pretreatments were applied to the seeds. These were the control (T0), shelled and unsoaked winged fruit (T1) and winged fruit soaked in cold water for 48 hours and then shelled (T2). Data collected using a data collection form were subjected to statistical analysis. Results showed that T2 treatment recorded the best germination rate (83%). In terms of seedling growth, the pretreatments had a significant effect on seedling diameter ($P > 0.05$). As for height, which averaged around 8 cm, and number of leaves, which averaged 6 per individual for each pretreatment, no significant effect was observed. However, for a multiplication of the species, the pretreatment (T2) where the winged fruits are soaked in ordinary water for 48 h and then shelled is recommended.

Keywords: *Mansonia altissima*; Multiplication; Winged fruits; Pretreatments; Ivory Coast

1. Introduction

Forests are a major source of the planet's terrestrial biodiversity [1]. Indeed, they are considered the world's leading reservoir of terrestrial biological diversity in terms of both species and ecosystems. In tropical zones, forests play an important role in climatic equilibrium and constitute a major reservoir of the planet's biodiversity [2]. Like most forests in tropical zones, Côte d'Ivoire's forests are a fundamental source of wealth for the country, thanks to the substantial income they generate from timber harvesting and the cultural and ecological services they provide to the population. Unfortunately, these forests, once considered one of the most diverse tropical ecosystems, are under threat from human activities [3]. Indeed, Ivorian forests are subject to strong anthropogenic pressures such as the installation of vast plantations, logging, urbanization, etc., which have resulted in the degradation of the forest cover [4]. This degradation of the forest cover has led to the disappearance of several plant species [5] in general, and local species in particular. Today, most of these local species are on the International Union for Conservation of Nature (IUCN) red list. This was the case *for MANSONIA ALTISSIMA* A. Chev. *MANSONIA ALTISSIMA* A. Chev, commonly known as the "Bété", is an endangered forest species on the IUCN Red List [6], due to its multiple uses. *MANSONIA ALTISSIMA* is used in a number of areas, notably for medicinal purposes, timber, handicrafts, agroforestry and fuelwood. For example, in the medicinal

* Corresponding author: Golou Gizèle ZANH

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field, the leaves and bark are used to treat fever [7]. Its trunk is used as timber [8,7]. It produces a semi-hard, semi-heavy wood with a density ranging from 0.85 to 1 when felled [8]. Given the importance of this species, conservation is a matter of urgency. In addition, seeds gradually lose their germinative power with storage time, making seed multiplication a delicate task. However, the use of preserved seeds is becoming increasingly necessary for the mass production of M. altissima and its reintroduction into its former preferred areas, given the scarcity of the species in these areas.

The objective of the study is to improve seed multiplication and seedling growth of M. altissima for use in reforestation. To achieve this, various treatments will be tested on M. altissima seeds in order to propose an accessible technique for lifting seed dormancy.

2. Material and methods

2.1. Study materials

Two (2) types of material were used: plant material and technical material. The plant material consisted of *MANSONIA ALTISSIMA* seeds. They came from the Bouaflé classified forest, in central- west Côte d'Ivoire. They were harvested in October 2022 and stored under ambient conditions (30°C, 50% humidity) for four (04) months. Experiments were carried out on winged seeds (Figure a) and wingless seeds (Figure 1b).

The tests were carried out at the Jean Lorougnon Guédé University in Daloa, in west-central Côte d'Ivoire. They were set up on February 15, 2023. Polyethylene bags measuring 15 cm x 10 cm were used as containers for the tests.

a: winged fruits; b: wingless seeds

Figure 1 *Mansonia altissima* seeds

2.2. Seed pretreatment

MANSONIA ALTISSIMA seeds were pretreated three (3) different pretreatments before sowing in order to lift their dormancy. These were as follows

- Control (T0): the winged fruits were sown directly with their shells, without treatment;
- Unsoaked shelled winged fruit (T1): the winged fruit were shelled and sown directly without prior soaking;
- Winged fruits soaked in cold water for 48 h, then shelled (T2): the winged fruits were soaked in ordinary water for 48 hours, then removed and shelled. The resulting seeds were then shade-dried for 30 min before sowing.

2.3. Seed planting and data collection

The seedlings were sown directly in black polyethylene bags with holes, containing a mixture of forest soil and sawdust, arranged by bed, sheltered from direct sunlight under a shade canopy. The *MANSONIA ALTISSIMA* beds were watered twice a day (morning and evening), except when it rained, for one month.

During the trial period, the number of days to first germination (germination delay or latency time) was recorded for each treatment. The number of germinated seeds per treatment was counted daily, as was the duration of germination.

2.4. Determination of *MANSONIA ALTISSIMA* seedling growth parameters

In addition to germination parameters, seedling vigour data were taken for two (02) months. For each treatment, measurements were taken on seedling height (H), collar diameter (D) and number of leaves (Nf) for all seedlings that survived. Seedling height was measured with a ruler graduated in centimetres. Neck diameter was measured with an electronic caliper in millimetres. The number of leaves on each seedling was counted. These growth parameters were assessed using a vigour parameter sheet for young plants.

2.5. Data analysis

The data collected were entered into Excel 2013. The following germination parameters were calculated: germination rate, total germination time and germination delay.

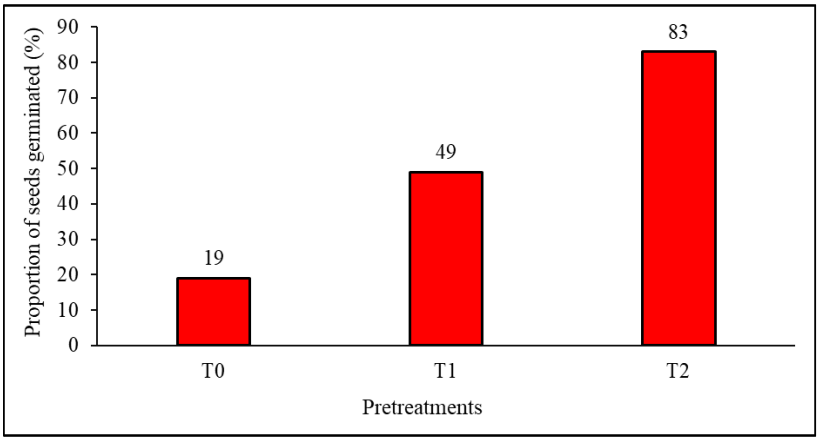
- The germination capacity or rate (TG) per treatment, expressed as the number of germinated seeds (ni) relative to the total number of seeds sown (N), was determined using the following mathematical formula: $TG\ (\%) = \frac{n_i}{N} \times 100$
- Germination time is the time between the date of first germination and the date of last germination.

Germination delay is the time in days between sowing and germination of each seed in a batch. It corresponds to the number of days required for each seed to germinate [9, 10, 12]. Daily counts of germinated seeds have enabled germination curves to be drawn up, representing cumulative germination rates as a function of time. Une analyse de variance a été réalisée afin d'évaluer la différence significative entre les différents traitements. Le test de Student a été utilisé pour la comparaison des moyennes.

3. Results

3.1. Effect of pretreatments on *MANSONIA ALTISSIMA* germination parameters

Analysis of the germination parameters of *Mansonia altissima* showed that pretreatments influenced the germination parameters of *MANSONIA ALTISSIMA* seeds. Thus, the best germination rate was recorded with treatment 1 composed of winged fruits soaked in cold water for 48 h then shelled with a value of 83%, followed by treatment 2 represented by unsoaked shelled seeds (49%). In contrast, the low germination rate of 19% was obtained with the control (T0), as shown in figure 2. In addition, germination times were statistically identical (P> 0.05) with the three pretreatments (T0, T1, T2). Germination times ranged from 13 to 27 days, with respective averages of 18.33 ± 3.93 days, 18.77 ± 4.94 days and 18.8 ± 4.52 days. In terms of germination time, treated seeds had a longer average germination time (15 days) than the control (11 days).



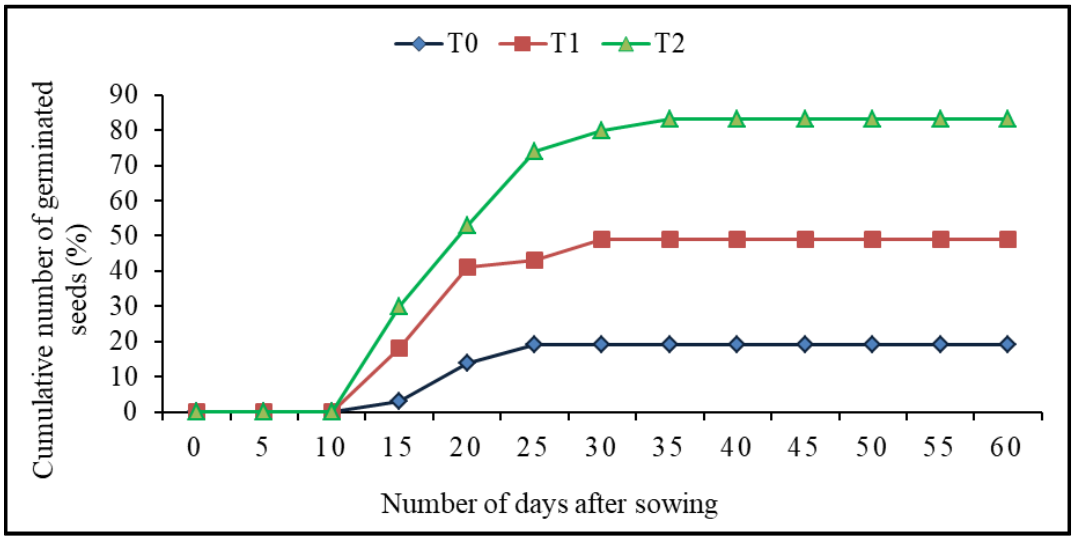
T0, Control; T1, unsoaked shelled winged fruit; T2, shelled winged fruit soaked in cold water for 48 hours, then shelled.

Figure 2 Germination capacity of *MANSONIA ALTISSIMA* seeds according to pretreatment

3.2. *Mansonia altissima* germination dynamics

The germination curves showed three phases of germination: a first phase of latency, corresponding to the number of days before the first germination; a second phase of acceleration of the germination rate, extending from day 10 to day

20 for the Control (T0), from day 10 to day 25 for T1 and from day 10 to day 30 for the T2 pretreatment. The third phase corresponds to germination rates after 30 days of observation for each pretreatment (Figure 3).



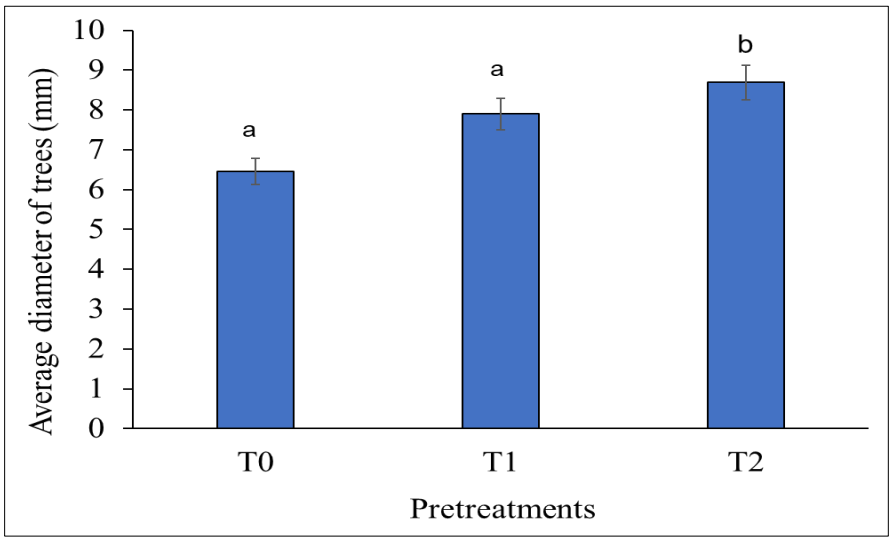
T0, control; T1, unsoaked shelled winged fruit; T2, shelled winged fruit soaked in cold water for 48 hours, then shelled.

Figure 3 Germination evolution of *MANSONIA ALTISSIMA* seeds subjected to three pretreatments

3.3. Effect of treatments on growth parameters of *MANSONIA ALTISSIMA* in the nursery

3.3.1. Effect of pretreatments on diametric growth of MANSONIA ALTISSIMA seedlings

Figure 4 shows the effect of different pretreatments on seedling diameter. Statistical analysis shows that there is a significant effect of the different treatments on mean seedling diameter ($P<0.05$). In fact, the average diameter of the seedlings of winged fruits soaked in water for 48 hours and then shelled (T2), with a value of 6.46, is statistically different from those of the control (T0) and unsoaked shelled winged fruits (T1), with values of 8.69 mm and 7.90 mm respectively (Figure 4).

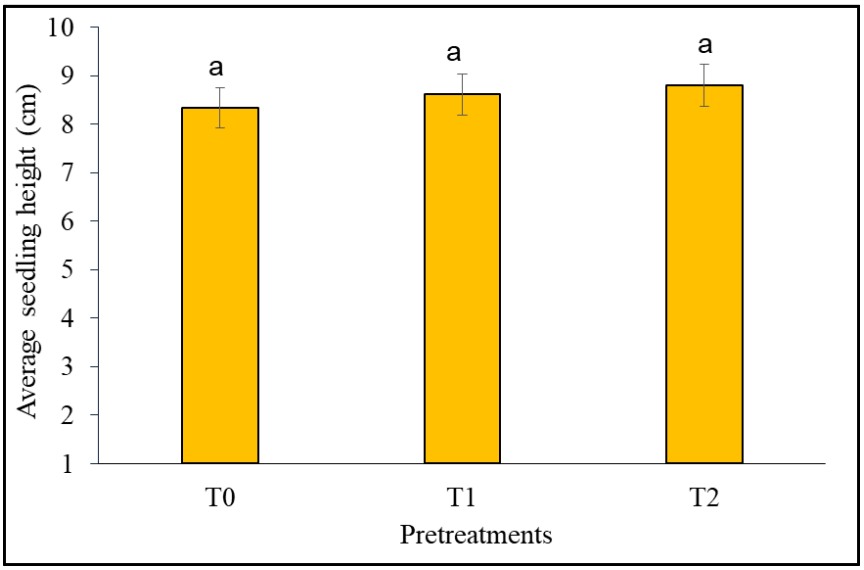


T0, control; T1, unsoaked shelled winged fruit; T2, shelled winged fruit soaked in cold water for 48 hours, then shelled.

Figure 4 Effect of three pretreatments on average seedling neck diameter

3.3.2. Effect of pretreatments on height growth and number of leaves of MANSONIA ALTISSIMA seedlings

A one-way analysis of variance (ANOVA) showed no significant effect of pretreatment on height (Tukey test, $P > 0.05$). However, the highest height value was observed with the treatment. In terms of average seedling height, the control, unsoaked shelled winged fruits and those soaked then shelled had values of 8.69 cm, 8.61 cm and 8.33 cm respectively (Figure 5). In fact, *M. altissima* seedlings subjected to different hormone treatments had no significant effect on collar diameter.

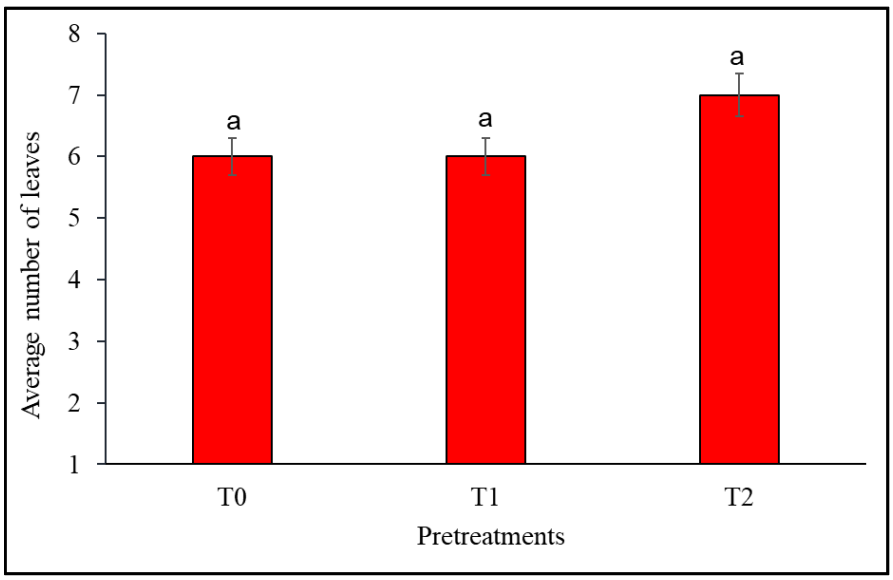


T0: Control; T1: Unsoaked shelled winged fruit; T2, shelled winged fruit soaked in cold water for 48 hours, then shelled.

Figure 5 Effect of different pretreatments on seedling height

3.3.3. Effect of pretreatments on the number of leaves on MANSONIA ALTISSIMA seedlings

Analysis of variance showed that there was no effect of pretreatment on leaf number. In fact, values were statistically identical ($P > 0.05$) between treatments. However, the Control (T0) recorded the highest mean value of 6.51 leaves, followed by hulled, unsoaked seeds (T1) and hulled fruits soaked in plain water for 48 h and then shelled, with mean values of 6.30 leaves and 5.93 leaves respectively (T2), as shown in figure 6.



T0: Control; T1: unsoaked shelled winged fruit; T2, shelled winged fruit soaked in cold water for 48 hours, then shelled.

Figure 6 Average number of leaves on seedlings as a function of pretreatments

4. Discussion

4.1. Effect of parameters on seed germination and seedling growth of *Mansonia altissima*

The best germination rate was recorded with treatment 1, which consisted of winged fruits soaked in cold water for 48 h and then shelled, with a value of 83%. Our results corroborate those of Chika et al [11], who obtained the best treatment for *M. altissima* germination with pickled seeds. In addition, the average germination time was between 11 and 15 days. This may be due to the 60-day spreading period. Our results corroborate those of Adji [12]. Indeed, this author showed in his work that the average germination time of species such as *Parkia biglobosa.*

Our analyses showed that the mean diameter was significantly influenced by the different pretreatments. Our results are similar to those of Zanh et al [13]. In their work, these authors showed that the different treatments significantly influenced the diameter of *E. ivorense* seedlings.

Our results also showed that the different pretreatments had a non-significant effect on the average height of the seedlings, which was around 8 cm for each pretreatment. Our results are similar to those of Kaya Bwana [14]. This author's research showed that the height of *D. boehmii* in the nursery was not influenced by the treatments. However, Sogo *et al*. [15] showed that the average height of *MANSONIA ALTISSIMA* seedlings was 14.5 cm. This difference could be explained by the duration of the experiment. In fact, the duration of our experiment was 60 days for the determination of growth parameters. On the other hand, Sogo *et al.* [15] in their study on *MANSONIA ALTISSIMA* obtained an average duration of 140 days. In terms of number of leaves, the different treatments also had a non-significant effect. Our results differ from those of Kaya Bwana [11]. Indeed, in his study on *D. boehmii*, this author showed a significant difference between the averages for the number of leaves for all treatments. This difference in averages could be mainly due to the age of the plant in the nursery.

5. Conclusion

This study tested the effect of different pretreatments on the germination of *Mansonia altissima*. Soaking the winged fruits in cold water for 48 hours and then peeling them resulted in a higher germination capacity, with a value of 83%. In addition, the various pretreatments had a significant effect on the diametric growth of the seedlings, which was not the case for their height and number of leaves. These results could help and/or guide the various players (nurseries, researchers, SODEFOR, etc.) in the multiplication of *MANSONIA ALTISSIMA* in order to contribute to its sustainability.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

The authors declare that there are no conflicts of interest.

References

[1] FAO and UNEP. The State of the World's Forests 2020. Forests, biodiversity and human activity. Rome, Italy, 2020

[2] Bamba I, Zanh GG, Kambiré B, Sangne YC, Barima YSS. Agrosystems and conservation of plant diversity in the periphery of the Haut Sassandra Classified Forest (Central- West Côte d'Ivoire). Eur. J. Sci. Res. 2019, 154(4) : 443-457.

[3] Ouattara SFP, Kouassi K, Dodiomon S. Diversity of Timber Species Threatened of Disappearance of Côte d'Ivoire Flora, in the Yapo-Abbé Forest. Eur. Sci.J., 2019, 15(36) : 213-229, http://dx.doi.org/10.19044/esj.2019.v15n36p213i

[4] Kouakou ATM. Spatio-temporal dynamics of plant cover and floristic diversity of some national parks and classified forests of Côte d'Ivoire in a context of political-military crises. Doctoral thesis in Plant Ecology, Jean Lorougnon Guédé University (Daloa, Côte d'Ivoire), 2019

[5] Kouakou KA, Barima YSS, Kouakou ATM, Sangne YC, Bamba I, Kouamé NF. Post-armed conflict plant diversity in the Haut Sassandra Classified Forest (Central-West of Côte d'Ivoire). J. An. Plant Sci., 2015, 26(2): 4058-4071.

[6] IUCN. Red List International Union for Conservation of Nature. 2021 www.iucn.org, consulté 05/12/2024

[7] Wédjangnon AA, Houètchégnon T, Ouinsavi C. Ethnobotanical characteristics and socio-cultural importance of *MANSONIA ALTISSIMA* A. Chev. in Benin, West Africa. J. An. Plant Sci., 2016, 29(3): 4678-4690.

[8] Foahom PB. The use of Bete (*MANSONIA ALTISSIMA* A. Chev., Sterculiaceae) in the management and regeneration of forests in Southern Cameroon. Woods and Forests of the Tropics, 1990, 226: 20-28.

[9] Amani A, Inoussa MM, Guimbo V ID, Mahamane A, Saadou M, Lykke AM. Germination and growth of four species of Combretaceae in the nursery. Tropicultura, 2015, 33(2): 135-145.

[10] Sagna CVN. Study of the cutting and germination of Guiera senegalensis J.F. Gmel. and Piliostigma reticulatum (DC.) Hochst, Master, specialty Water and Forest, Higher Institute of Agricultural and Rural Training, Alioune Diop University of Bambey, Senegal, 2020.

[11] Chika PJ, Sakpere AM, Akinropo MS. Effect of pretreatments on germination of seeds of the timber plant, Terminalia ivorensis and *MANSONIA ALTISSIMA* (a. Chev.). Not. Sci. Biol., 2020, 12(2): 334-340.

[12] Adji BI. Architecture and structure-function modeling of indigenous agroforestry species in Côte d'Ivoire: case of Khaya senegalensis (Desr.) A. Juss. (Meliaceae), Pterocarpus erinaceus Pear. (Fabaceae) and Parkia biglobosa, Jack, R. Br. (Fabaceae). Doctoral thesis in Tropical Agriculture and Forestry, Jean Lorougnon Guédé University, Daloa, Côte d'Ivoire, 2022.

[13] Zanh GG, Tokpa LZ, Assale AAY, Adji BI, Barima Y.S.S. Effect of three pretreatments on germination and nursery growth of Erythrophleum ivorense A. Chev, a little-known timber species in Cote d'Ivoire. GSC Advan. Res. Rev., 2024, 21(01) : 456–462

[14] Kaya Bwana HH. Generative multiplication and nursery growth of Dalbergia boehmii Taub. (Fabaceae) in Lubumbashi. Master's thesis, Faculty of Agricultural Sciences, Lubumbashi University, Democratic Republic of Congo, 2022.

[15] Sogo M, Etsè KD, Kamou H, Damigou B, Padakali E, Guelly KA. Germination characteristics of seeds and growth rate of young plants of two forest species in Togo: Detarium senegalense JF Gmel. (Fabaceae) and *MANSONIA ALTISSIMA* (A. chev.) (Sterculaceae). Afri. Sci., 2017, 13(4) : 275-285.