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Influence of Humid Treatments on the Germination of Two Local Fruit Trees in Two Climate-smart Villages in the Sudano-Sahelian Part of Cameroon

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Abstract: The seeds of several agroforestry species are dormant, and their germination is important for the growth, development, and conservation of the species. To facilitate seed germination, this study determined the effect of moisture treatments on seed dormancy breaking of two species, *Tamarindus indica* and *Adansonia digitata*, in two climate-smart zones. For each location, 500g of seeds were set aside for each experimental treatment: the warm-moist treatment, the cold-moist treatment, and the control treatment. Germination rates were assessed over a 30-day period, and growth parameters were measured over a 30-day period. The trial was conducted over a two-month period. The best performance was achieved with the warm-moist treatment for both species identified in this study. The average germination rates obtained were 76% for tamarind and 69% for baobab. The best mean height values obtained varied from 15.39 cm for baobab to 12.59 cm for tamarind. As for the diameters, the average was 8.4 mm for baobab and 3.83 mm for tamarind. For the number of leaves, the best records were on average 5 leaves/plant for baobab and 4 for tamarind. The hot wet treatment was a better technique for regeneration and improving the sustainability of tamarind, baobab and other native species.

Keywords: Baobab; Climate-smart zone; Dormancy; Seed; Tamarind; Warm-wet and cold-wet.

INTRODUCTION

In the Sudano-Sahelian region of Cameroon, as in other developing countries, the population derives a large portion of its food and income from woody forest products such as timber and fodder, and non-woody forest products such as fruits and leaves. According to Folefack and Abou (2009), over 77% of the population uses more than 76% of tree products. Uncontrolled exploitation of native fruit trees in the locality and the influence of climate change are causing the decline, or even disappearance, of certain species important to the population of Cameroon. Among the most widely used species are: *Tamarindus indica* and *Adensonia digitata* (Muhammad and Amusa. 2003). All parts of these trees are important, particularly the nuts, from which oil is extracted as an essential raw material in the cosmetic industry and in traditional medicine (Abubakar and Attanda, 2022). In view of the exploitation of these seeds and the challenges experienced in the Sudano-Sahelian part of the country, there is an urgent need to search for alternative solutions to ensure sustainable and efficient agriculture.

The dissemination of woody species in agroforestry is very difficult and uncontrolled. It is generally ensured by one of the methods that nature disperses seeds of plants. Indeed, seeds, whether fruits-borne or not, are likely to be transported by various agents. The wind is responsible for the transport of a multitude of seeds. Apart from this physical agent, animals (mammals, lower animals, insects, etc.) play a major role in the propagation of plant species. Birds have a strong capacity for seed propagation given their strong ability to move (Rashford, 2023). Apart from propagation ensured by disseminating agents, the perpetuation of seeds of forest species is ensured by farmers. Dormancy is an obstacle to germination that occurs in a varied way depending on the species and certain environmental factors favorable for seed germination (Abubakar and Attanda, 2022). Several techniques are generally used to facilitate the breaking of dormancy in these species such as mechanical and thermal shock of the seed coat, and soaking of seeds in sulfuric acid. The objective of this study is to improve the production of *Tamarindus indica* and *Adensonia egyptiaca* plants by using easy and accessible methods of breaking dormancy of seeds even to small producers of climate-smart villages of agro-ecological zone-I.

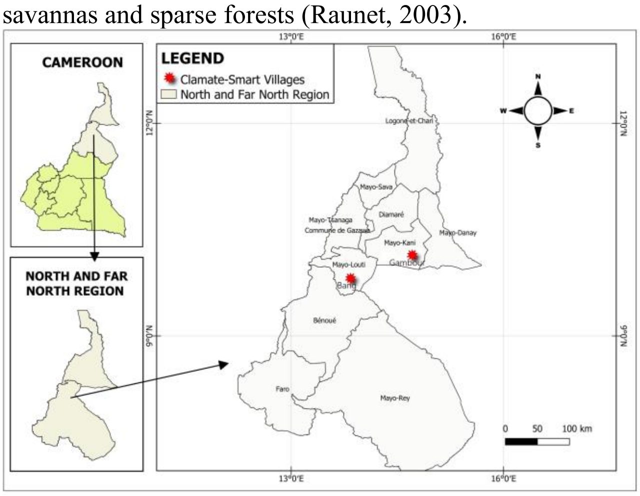
MATERIALS AND METHODS

Study Site

This experiment was conducted in two climate-smart villages in the Sudano-Sahelian zone of Cameroon, namely: Bang and Gambour (figure 1). The Sudano-Sahelian region covers two administrative regions, the North and the Far North.

The Far North is the most densely populated region of Cameroon. Its climate is Sudano-Sahelian type with a long dry season, characterized by significant sunshine and very high temperatures, and a rainy season with rainfall varying between 400 and 1100 mm (Seignobos and Iyébi-Mandjek, 2000). In this part of the country, the vegetation is a wooded savannah, covered with grass dotted with shrubs, forest galleries, a thorny steppe in the plain and in the massif. Its terrain consists mainly of plains and mountain ranges. There is a varied type of soil such as: sandy soils, loamy soils, vertisols.

The climate of the North Region of Cameroon is of the Sudano-Sahelian type too. This region is characterized by a well-defined dry and rainy season. The dry season lasts from December to May, with a pick of 40-45 ^{0}C of temperature in April and a short rainy season from june to September, the rainfall being between 800 and 900 mm of water per year (Morin, 2000). The natural vegetation is mainly dominated by grassy, tree-covered, shrubby savannas and sparse forests (Raunet, 2003).



Source: SOGEFI 2019, Projection WGS 84/UTM Area 32N *October 2024*

Figure 1: Location map of the study area

Seed collection

The experiment was carried out from June to November 2022 at the Bang and Gambour nursery sites.

The plant material used consisted of dried tamarind and baobab seeds. Tamarind pods and baobab fruits were collected from producers in the various localities. Once collected, the tamarind pods were shelled to obtain the seeds, and the baobab fruits were split with a machete. The fruit contents were soaked in water and washed to remove the baobab powder to obtain the baobab seeds.

Once the seeds were obtained, pretreatment was performed using the method developed by Koubala et al. (2011), which consists of sorting to purify by eliminating juvenile, damaged, and non-compliant seeds.

Seed Treatment to Break Dormancy

For the experiment, 1.5 kg of seeds from each species and from each climate-smart village were selected and distributed as follows:

- 500 g of seeds per species for the warm-moisture treatment (T1);
- 500 g of seeds per species for the cold-moisture treatment (T2);
- 500 g of seeds per species for the control treatment (T0).

Methodology

Hot-moist treatment (T1)

This is a traditional technique, less expensive and very easy to practice. It involves boiling the seeds in a saucepan until they reach 100°C (212°F), adding them, and letting them boil for three minutes. Then, remove them from the heat and let them soak for three days, changing the contents to water. On the third day, first remove the supernatant, then collect the remaining seeds for sowing.

Cold-moist treatment (T2)

This is an old method commonly used by farmers to moisten seeds. It is generally applied to seeds that do not have germination problems at the time of sowing. This method involves to soak the grains for 24 hours in water at room temperature, sieve the excess seeds, and sow those remaining.

Experimental design

Our design consisted of a simple block with three replicates for each treatment per species. Each block consisted of 100 pots per treatment, a total of 300 pots for the tamarind species and 300 pots for the baobab. Parameters were recorded on 30 central plants per treatment and per replicate. The various parameters evaluated were as follows:

- Emergence rate: This parameter was recorded every day for 1 month;
- Growth parameters: These parameters were recorded twice a month for two months. These were:
  - Plant height;
  - Collar diameter;
  - Leaf number.

Potting Soil

The soil used came from the plot reserved for the trial at each site. The soil was diluted with organic matter from small ruminants in a ratio of three-quarters soil to one-quarter organic matter.

The potting bags were made of 17 x 20 mm polyethylene plastic, equivalent to 1 L.

Sowing Technique

The sowing technique consisted of making a hole with a diameter twice that of the seed to be sown. Three seeds were sown in each pot. One month after sowing and after taking the emergence rate, thinning was performed.

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Data Analysis

The data collected in the field were classified in Excel. Analyses of means, standard deviations, and variances (ANOVA) were performed using Stat graphic software. XLSTAT software was used to perform principal component analyses.

RESULTS

The effectiveness of germination techniques for local fruit species, not yet domesticated in the Sudano-Sahelian region of Cameroon, made it possible to evaluate the emergence rate and growth parameters of tamarind and baobab.

Emergence Rate

The emergence rate of tamarind pots for the hot-moisture treatment yielded average percentages of 76%, for the cold-moisture treatment, 37%, and for the control 0%. The results show that all germination techniques have emergence rates except for the control. However, the averages for the hot-moisture treatment applied to tamarind seeds are higher than for the other treatments. There is a statistically significant difference between the tamarind emergence means between the wet and warm treatments ($F = 332.159$; $P < 0.05$)

Data analysis for baobab emergence yielded mean percentages of 69% for the wet and warm treatment, 22% for the wet and cold treatment, and 0% for the control. This shows that all germination techniques have similar emergence rates. However, the means for the wet and warm treatment applied to tamarind seeds are higher than for the other treatments. There is a statistically significant difference between the tamarind emergence means from one wet treatment level to another ($F = 281.756$; $P < 0.05$). Figure 2 below is the statistical representation of the emergence rate of the different tamarind and baobab seed germination techniques.

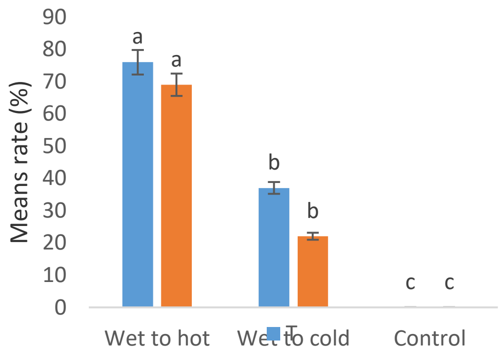

Figure 2: Seed emergence rate of tamarind and baobab

Plant height

Figure 3 shows that the wet and hot treatments provide the best heights for both species studied. The respective means expressed in cm for the baobab and tamarind are 15.39 ± 2.82 and 12.59 ± 1.77. For the wet and cold treatment, the mean values of the heights for the baobab and tamarind are respectively 0.73 ± 0.01 and 1.03 ± 0.01. For both species, the control is zero. For both species, the ANOVA analysis decomposes the variance of the heights into two components: an inter-group component and an intra-group component. In these respective cases for the baobab as for the tamarind the ratio $F = 589.435$, and $F = 332.159$ are ratios of the inter-group estimates compared to the intra-group estimates. As the value of the probabilities for the F tests < 0.05, there is a statistically significant difference between the height means from one treatment level to another at the 95.0% confidence level. Figure 2 is the schematic illustration of the results obtained on the heights.

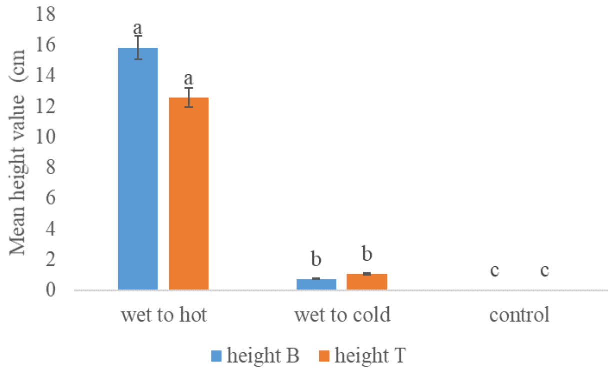

Figure 3: Effect of wet treatments on the height of baobab and tamarind plants

Diameter at the root collar of the plants

As for the plant collar diameter parameter, data analysis shows that for both species studied, the hot wet treatment stands out with an average collar diameter value of 8.46 ± 2.41 mm for the baobab and an average collar diameter value of 3.83 ± 0.64 mm for the tamarind. The cold wet treatment shows an average collar diameter value of 0.51 ± 0.01 mm for the baobab and an average collar diameter value of 0.87 ± 0.01. For the control treatment, all values obtained for both species studied are zero.

The ANOVA analysis decomposes the variance of diameters into two components: a between-group component and two within-group components. The ratios, which in these cases are $F = 283.22$ for baobab and $F = 181.733$ for tamarind, are ratios of the between-group estimate to the within-group estimate. As the probability values for the F test < 0.05, there is a statistically significant difference between the diameter means from one treatment level to another at the 95.0% confidence level. Figure 4 three is the representation of the diameters at the necks for the two species as a function of the treatments

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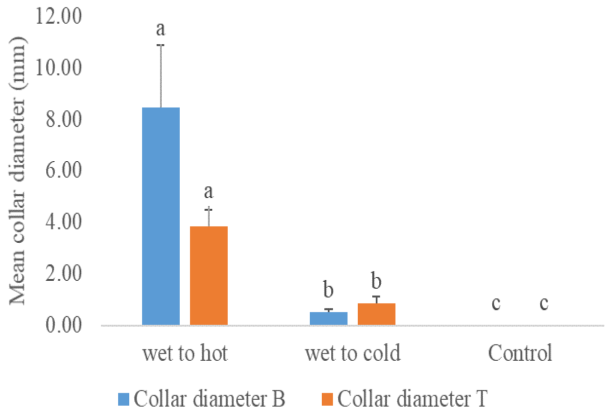

Figure 4: Diameters at the collars of baobab and tamarind

Number of leaves

Figure 5 shows the results obtained for the number of leaves. It appears that the wet-to-hot treatment for both species gives the best results. The average values obtained for the wet-to-hot treatment are 5 ± 0.9 leaves for the baobab and4 ± 1.1 leaves for tamarind. The cold-wet treatment recorded mean values of 1 ± 0.01 for tamarind and 1 ± 0.03 for baobab. The control treatments, on the other hand, were zero.

ANOVA analysis decomposes the variance in leaf counts into two components: a between-group component and a within-group component. The ratio, F = 42.025 for baobab and F = 314.842, are ratios of the between-group estimate to the within-group estimate. As the probability value for the F test is < 0.05, there is a statistically significant difference between the leaf count means across treatment levels at the 95.0% confidence level.

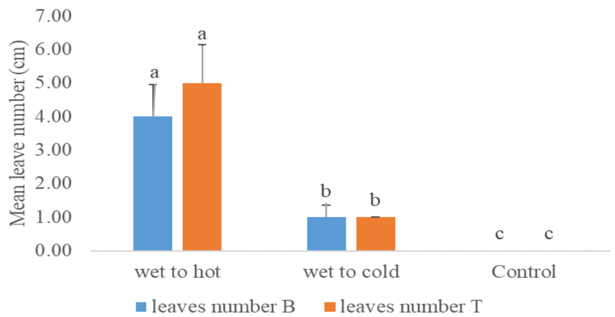

Figure 5: Leaf count of tamarind and baobab plants

Multivariate analysis

The analysis of several growth parameters of tamarind and baobab plants from three pretreatments allowed us to perform principal component analyses (PCA). Figures 6 and 7 show the variables of the effects of pretreatments on the growth of the plants of the two species studied. The results obtained for the two species studied give an inertia of 100%, which is distributed across the two axes (F1 and F2). Here, the variability of the two species is perfectly represented in the plant. For tamarind (Figure. 6), axis 1 explains 99.58% of the variability in plant diameter growth and leaf number. Axis 2 explains 0.42% of the variability in height growth and seed emergence percentage. For the baobab (Figure 7), axis 1 explains 84.11% of the variability in plant diameter growth and leaf number. Axis 2 explains 15.89% of the variability in height growth and seed emergence percentage. For both species, all these parameters are correlated with the hot wet pretreatment.

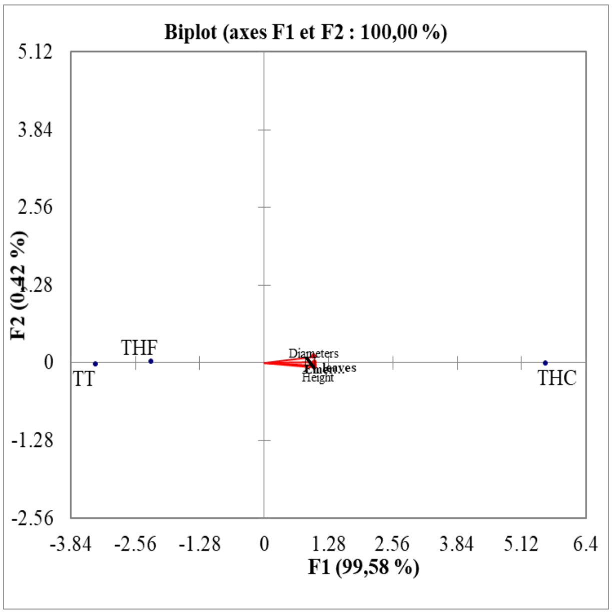

Figure 6: Principal component analysis for tamarind plants

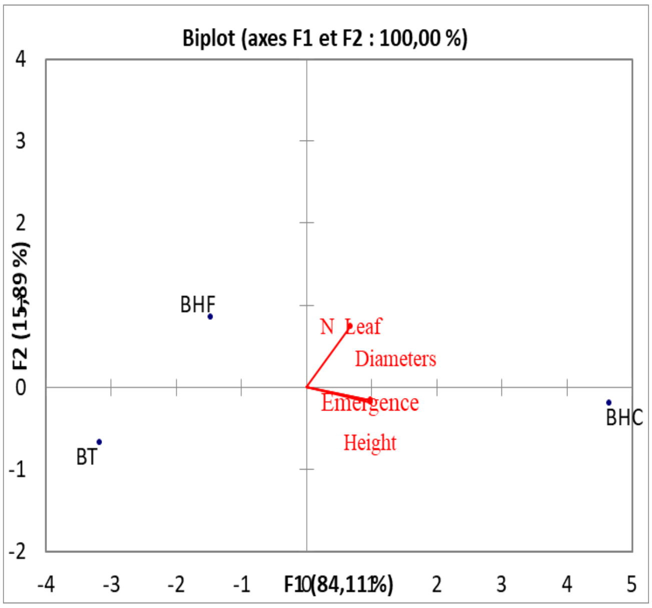

Figure 7: Principal component analysis for baobab plants

DISCUSSION

The results obtained in our study reveal that the seed coats of the highlighted species are very hard and impermeable to oxygen and water, which does not facilitate their germination. This is the case with our control treatment, which yields 100% ungerminated seeds, and

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confirms the thickness and hardness of the seed coat as previously found by Danthus et al., (1995) and Skerman, (1982) on *Adansonia digitata*. For all our tested treatments in both species, the results were similar. For the hot wet treatment, which consisted of soaking the seeds in boiling water for three minutes over a fire, the germination rate was satisfactory with 76% for the tamarind and 69% for the baobab. The influence of the temperature during boiling (100°C) made it possible to weaken the seed coat and make it permeable to air and water. Subsequently, soaking made it possible to moisten and swell the seeds. This result is comparable to those obtained by Razanameharizaka et al., (2001) on *Adanasonia robrostica*. This author obtained a 95% germination rate of plants by combining boiling water plus scarification of the seeds. This same author obtained a result of 80% germination after subjecting the seeds to a treatment with sulfuric acid for 12 hours and then to boiling water for three minutes. We note that of the two treatments used by this author, the boiling water treatment was used. In the same vein, Garba et al., (2020) obtained a high germination rate after subjecting tamarind seeds to a pre-treatment with boiling water at 100°C. The pre-treatment with boiling water appears here to be the appropriated treatment for obtaining a good seed emergence rate of baobab and tamarind. The results of this study are also in agreement with those of Muhammad and Amusa (2003); Abukar and Muhammad (2013); Bello and Gada (2015) who obtained a germination rate of 80% of tamarind seeds pretreated in boiling water at 100°C. This solution softens the seed coat and thus promotes its permeability to water and oxygen as previously confirmed by findings of Aliyu et al., (2023) on tamarind.

For all treatments, the germination rate evaluation period lasted 30 days. The evaluation of growth parameters for another 30 days (one month) shows that, regardless of the species studied, the boiling water treatment gives the best results on all the parameters evaluated. For the baobab, we obtain 15.39 cm in height, 8.46 mm in diameter and 5 leaves on average. For the tamarind, we had 12.28 cm in height, 3.82 mm in diameter and 4 leaves on average. The results obtained here are contradictory to those on the tamarind by Garba et al., (2020). The work of this author rather shows a better result on the growth parameters of tamarind plants subjected to the control treatment. He obtains 35.8 cm in height and 5.97 cm in diameter. This is explained by the fact that the seeds had previously been preserved for a long period (18 months). Aliyu et al. (2023) confirms that pretreatments influence the growth of tamarind plants. He obtains an average height of 13.9 cm on tamarind plants that is similar with previous findings of Kishore et al., (2022).

CONCLUSION

The germination of *Tamarindus indica* and *Adansonia digitata* under natural conditions takes a long time due to the hardness of their coats. This characteristic of the coat creates dormancy, which slows the germination process of these two species studied. Consequently, analysis of the data obtained showed that when *Tamarindus indica* and *Adansonia digitata* seeds undergo a humid and hot treatment, they can achieve better germination rates and good seedling growth parameters. The humid and hot treatment has the particularity of making the seed coats permeable to water and oxygen. The results obtained in this study could be used to improve the replication of *Tamarindus indica* and *Adansonia digitata*, which are commonly used for several purposes in Africa.

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Conflicts of interest

The authors of this article declare that they have no conflicts of interest.

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