

# Evaluation of the Ex-situ Reproductive Capacity of *Flemingia faginea* (Guill.& Perr.) Baker, a Species of Medicinal Value in Burkina Faso

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## Abstract

In Burkina Faso, medicinal plants are used mainly by the most vulnerable populations (70%). This study aims to promote the *ex-situ* reproduction of *Flemingia faginea* to make it accessible as a remedy for high blood pressure. Sexual reproduction of *Flemingia faginea* was carried out to evaluate the effect of 2 pre-germination treatments on the seeds' germination rate. One pre-germination treatment included soaking seeds in tap water for 24h (T1), another soaking

in boiling water until cooling for 24h (T2) while the control experiment did not have any pre-germination treatments (T0). We used seeds from two provenances: North-Sudanian (NS) and South-Sudanian (SS). The germination percentage and mean germination time (MGT) were calculated; additionally, the seedling height, diameter, leaves production were monitored for 2 months. The variance analyses fit to tukeys tests were used to compare the effects of the various treatments on germination rate, mean germination time and seedling growth. The best germination rate was obtained with T0 (96% NS and 79% SS). The best mean germination time (MGT) was 7.25 days T2. The best seedling growth was obtained with T0 and T1 (P=0.000). As the provenance is concerned, the NS provenance was the best source for germination capacity, for the best seedling growth. A test using seeds from NS combined at T0 conditions provides optimal conditions for production of *F. faginea* at almost no cost to the local population.

**Keywords:** *Flemingia faginea*, sexual reproduction, seedling growth, germination, *ex-situ* reproduction, Burkina Faso

## 1. Introduction

According to the World Health Organization 80% of the world's population in developing countries partly or exclusively depend on traditional medicine for their health care. Traditional medicine that is passed from generation to generation (sometimes as a socio-cultural heritage), has existed for many decades in these regions (Compaoré *et al.*, 2018).

In Burkina Faso, traditional medicine remains the main source of primary health care for 70% of the country's population (Zerbo *et al.*, 2011). Therefore, ethnobotanical studies remain represent a fundamental link between modern scientific knowledge and indigenous knowledge of the local population. Ethnobotanical studies in the country provide information on the use and value of plants such as the inventory and the use of medicinal plants by specific ethnic groups (Ouoba *et al.*, 2006; Bélem and Nana, 2009; Zerbo *et al.*, 2011). Additionally, some studies have been conducted on the aqueous extracts of certain medicinal plants to be used, for the treatment of hypertension (Bélemtougri *et al.*, 2007), as antiseptics, analgesics and diaphoretics (Ouattara-Danté *et al.*, 2003), for the treatment of bacillary dysentery (Millogo-Koné *et al.*, 2007), as anti-nociceptive and anti-inflammatory therapies (Konaté *et al.*, 2018) and as treatment against cervical cancer cell lines (Ouattara *et al.*, 2019).

Furthermore, these researcher studies have also demonstrated the vulnerability and rarity of many medicinal species (Traoré *et al.*, 2011; Koadima, 2008; Ouédraogo, 2006). However, this does not currently bother rural and urban populations. To date, the most domesticated plant species are ornamental plants and crops and the local population has dedicated their efforts to reproduce and improve the variety of domesticated plants to the detriment of medicinal plants. The cultivation of medicinal plants could contribute to their conservation and sustainable management.

In the literature, *Flemingia faginea* is a medicinal plant that is used to regulate human blood

pressure (Dembelé, 1988; Cissé *et al.*, 2016). The prevalence of high blood pressure has been on the increase in Burkina Faso. High blood pressure affects all age groups, however, pregnant women and the elderly living in both villages and cities bear the brunt of this disease. Despite the well-known medicinal value of *F. faginea*; limited research has been focused on its' species in Burkina Faso. *F. faginea* is mainly found in the southern part of the country in habitats around the banks of a few permanent streams of rivers. Unfortunately, its adaptation to the wetlands may make it vulnerable to global warming and its disappearance from its natural habitat.

The objective of this study was to popularize the ex-situ reproduction of *F. faginea* and make it accessible as a remedy for high blood pressure by, i) assessing the regeneration capacity of its' seeds and, ii) to determining the growth development parameters of its' young plants.

## 2. Materials and Methods

### Geographical location of seed collection sites

The seeds of *Flemingia faginea* were collected from three sites located in two phytogeographical climatic regions of Burkina Faso, i.e. Ouô and Dougoumato located in the south-Sudanian climate and National Park of Kaboré Tambi (PNKT) located in a north-Sudanian climate (Fontès and Guinko, 1995). Figure 1 below shows the location of the seed collection and testing sites.

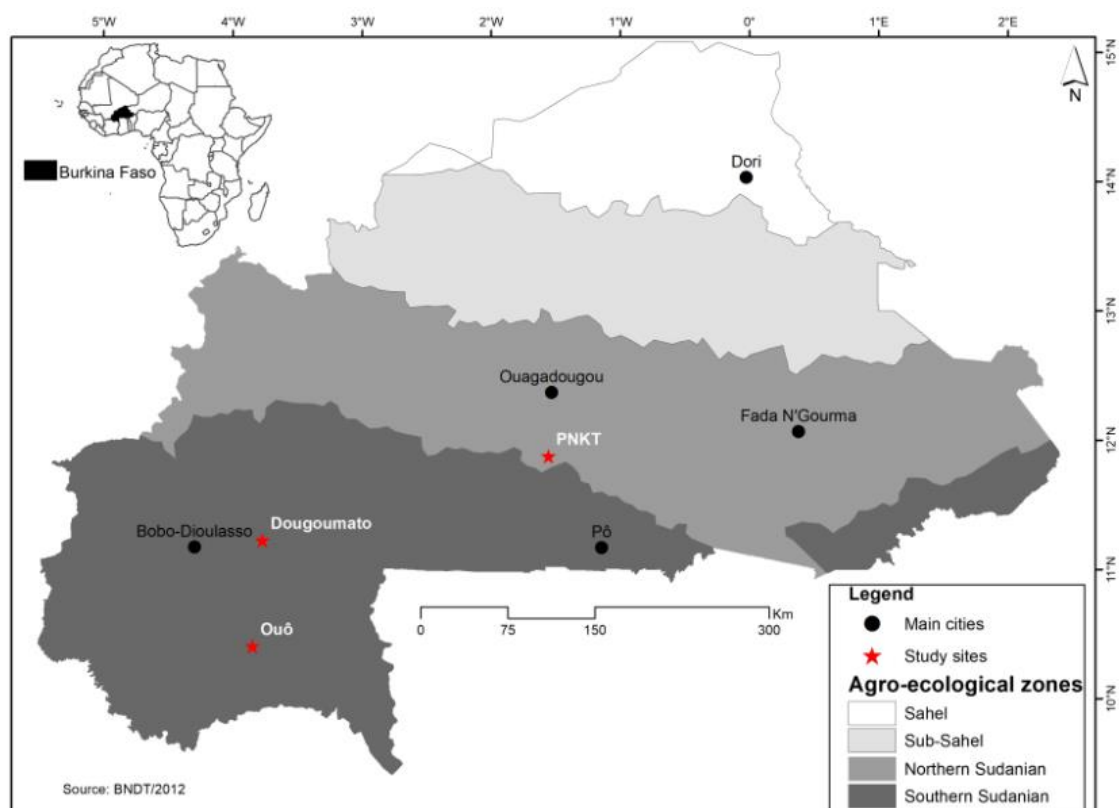


Figure 1. Location of the seeds collection sites

### Seed harvesting and Seed preparation

Because the fruit of *F. faginea* is dehiscent, mature fruits were harvested before the seeds were dispersed by the mother plants. Harvesting took place from the 2<sup>nd</sup> to the 25<sup>th</sup> of April 2019 on a minimum of thirty (30) plants at each site. The phenology of the species is progressive, therefore, harvesting was done on the mother plants and respective dried fruits in a successive fashion. The harvested fruits were then packed in paper envelopes labelled with the date of harvest and origin of the plant). After each harvest, these fruits (photo 1) were stored in a dry place away from rodents and insects until the end of the harvest.

In the laboratory, the seeds were first prepared in batches according to site of origin. The pods were peeled to separate healthy seeds from impurities. Finally, using a magnifying glass, sorting was done and the healthy seeds were identified as those that were vigorous and without attack from insects.



Photo 1. *F. faginea* fruits (A); Fruits with one or two seeds inside (B)

### Seed moisture content test

The water content (TE) test was carried out on the 22<sup>nd</sup> of May 2019 in accordance with ISTA rules of 2015. For the North Sudanian (NS) provenance, this was carried out in four (4) replicates with three (3) seeds per replicate; for the South Sudanian (SS) this was done in 4 replicates with ten (10) seeds per replicate. The variation in number of seeds per provenances was due to the limited number of seeds from the NS provenance.

This process first included weighing each dry empty cup (P') and followed by the same cup filled with fresh seeds (PF) (P'').

The seeds were then dehydrated in an oven at 103°C for seventeen hours (17h). Following this, the seeds were cooled for 45 minutes by incubation in a desiccator containing silica gel to avoid. Repeat weighing was done on an electronic scale to obtain the weight of the dry

seeds (PS).

The following formula was used to calculate the moisture content (MC) of the seed sample (ISTA, 2015):

$$MC (\%) = (\text{Weight of Fresh seeds} - \text{Weight of Dry seeds}) / \text{Weight of Fresh seeds} \times 100$$

Where MC = moisture content of the seeds;

### **Seed germination capacity**

#### *Pre-germination treatment*

For each provenance, dry seeds were randomly divided into three lots. Two of the three batches each underwent a different pre-germination treatment proposed by Baglo (1998) and Laouali *et al.*, (2015) to remove seed dormancy whereas one lot was used as a control. Three seed treatments considered are presented in Table 1 below:

Table 1: Abbreviations and meaning of pre-germination treatments

Pre-germination treatments abbreviations	Meaning of the different pre-germination treatments
T0	Control: Seeds which have not received any pre-germination treatment
T1	Soaking: Soaking the seeds in tap water at room temperature for 24 hours.
T2	Boiling: Soak the seeds in tap water boil at about 100°C and leave to cool for 24 hours.

#### *Seed germination*

In May 2019, germination tests were carried out to test the viability and germination capacity of the seeds. Germination was carried out in Petri dishes of 10 cm in diameter containing sterilised cotton that served as a substrate to retain moisture (Photo 2). Each lot (T0, T1 and T2) from each provenance was repeated 4 times at a rate of 25 seeds per box (Kheloufi and Mansouri, 2017). The operation consisted in wetting the substrate contained in each Petri dish prior to laying out the 25 seeds and then closing the dish.

The conditions for germination were as follows:

the Petri dishes containing sowed seeds were laid out on a laboratory bench The neon bulbs in the room remained lit day and night during the test period to provide continuous white light to the seeds. During this period, the seeds were watered using tap water as needed to keep the substrate moist.

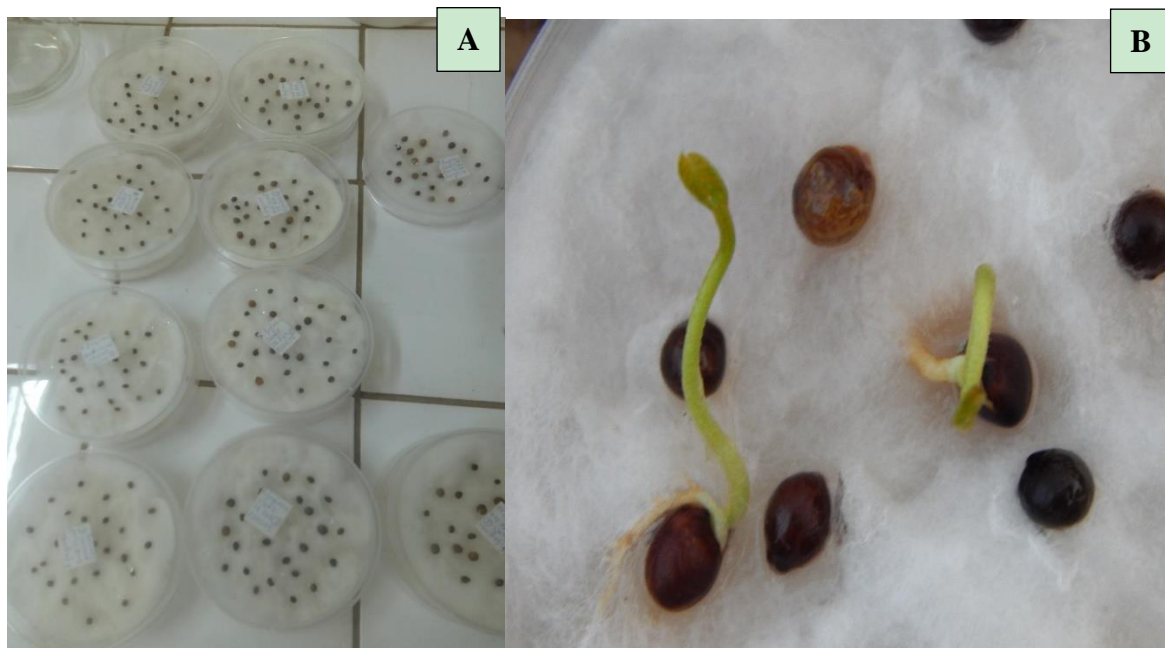


Photo 2. Seeds in Petri dishes (A) and seedling before transplanting (B)

The germination criterion selected was the emergence of the young rootlet out of the seed coat (Laouali *et al.*, 2015). The number of germinating seeds was documented each day on a record sheet.

The following germination parameters were computed for each source:

The germination rate (T) or germination capacity, i.e. the ability of the seeds to develop after being placed in favourable conditions for germination, was calculated formulas follows (Moupela *et al.*, 2013):

$$T = G \times 100/N$$

Where

G = number of germinated seeds

N = number of seeds germinated per treatment.

The mean germination time (MGT) i.e. the time after which 50% of the seeds would have germinated seeds was calculated formulas follows (Berka and Harfouche,

2001): 
$$MGT = \frac{\sum_{i=1}^n (n_i \times t_i)}{N}$$

With  $n_i$  is the number of seeds germinated at time  $t_i$  (i ranging from 1 to n) and N is the number of seeds germinated at the end of the test.

### Plant production in nursery

#### *Substrate composition*

A nursery substrate was used to evaluate seedling growth in a greenhouse. This substrate was obtained by homogeneously mixing three (3) volumes of soil, one (1) volume of sand and one (1) volume of manure and placing it in small pots (250mm x 70mm). Following this, the substrate was graded and watered before transplanting began.

#### *Experimental transplanting device and seedlings transplantation*

The experimental device used was a complete randomized block with two repetitions by pre-processing for each source.

The transplanting took place from the 29<sup>th</sup> of May 2019 to the 19<sup>th</sup> of June 2019. As germination was spread out over time, transplanting was done on a daily basis as the seeds germinated in the laboratory. The transplanted seedling could only have developed a maximum of its' first two leaves. Thirty (30) seedlings per batch of treated seeds (T0, T1 and T2) from each provenance were transplanted into individual substrate pots. During the transplanting process, all dead seedlings were immediately replaced.

The transplantation process involved watering the substrate and then inserting a wooden stick in the middle of the substrate to create a hole for the seedling radicle. Single seedlings were taken from the box using a pair of pliers and placed in the cavities dug in the substrate. Finally, the hole was carefully filled and the soil was packed around the seedling (photo 3). In this way, the germinated seed was completely covered with soil if only the radicle alone had emerged. In the event it was a seedling, its' leaves were left uncovered on the surface. Watering was done at the end of this process.



Photo 3. Seedling transplantation

#### *Monitoring of seedling growth*

The consisted mainly of:

- daily watering (morning) of seedlings in the event it did not rain;

- clearing herbaceous in the pots and between plots to minimise herbaceous competition.
- Ensuring that the average environmental temperature and humidity were  $29.38 \pm 2.24$  °C and  $68.74 \pm 6.40\%$ , respectively.

Measurements begun four (4) weeks following transplantation. These measurements were taken at weekly intervals for two months. The following parameters were measured for each seedling:

Growth and development parameters were measured as follows:

- diameter at the collar where the calliper was used to take the measurements;
- height of the seedlings was taken from the collar to the terminal bud of the stem
- leaves were counted from the base of the stem to the apical end. The number of branches.

The evolution of the survival rate (Sr) which shows the ability of the seedlings to survive throughout the observation period was calculated as follows (Moupela *et al.*, 2013):

$$Sr (\%) = \frac{\text{Number of live seedlings}}{\text{Initial number of transplanted seedlings}} \times 100$$

### Data analysis

The data were recorded using an Excel 2013 spreadsheet. Curves and graphs were plotted using MsExcel and various measures were calculated (germination rate, MGT). Minitab 2018 software was used for descriptive and variance analyses. A comparison of the mean values was then carried out by applying the Tukey test to the 5% significant probability threshold using the same software.

### 3. Results

#### *Moisture content of seeds at harvest*

The initial moisture content (MC) was 9.03% for the South-Sudanian (SS) and 8.25% for the North-Sudanian (NS).

#### *Effects of pre-germination treatments on germination according to provenance*

The seeds from NS, the control treatment T0 had the highest germination rate (96%). This was followed by soaking in tap water at room temperature for 24 hours (T1), which was 90% and the lowest rate was observed in the boiling water treatment (T2) which had a rate of 59%.

For seeds from SS, T0 and T1 gave germination rates of 79% and 67%, respectively. Whereas, T2 had the lowest germination rate of 49%.

#### *Effects of pre-germination treatments on latency and on the time between the first and the last germination*



For both provenances, the results show that germination of the three treatments of the NS provenance (T0, T1 and T2) started at the same time (two days after sowing) and then T0 takes precedence over the other two, T1 and T2. We can thus distinguish 3 phases, when the curves of the speed of germination is draw:

- A first phase of latency from 0 to 1 day, corresponding to the time of imbibition of the seeds.
- A second phase of acceleration of germination.

For the NS origin, acceleration of germination extended for 35 days (from the 2nd to the 36th day) for control seeds (T0); for 40 days (from the 2nd to the 41st day) for seeds soaked in water at room temperature (T1) and for 17 days (from the 2nd to the 18th day for seeds soaked in boiling water (T2).

For the SS origin, the acceleration of germination extended for 46 days (from the 2nd to 47th day) for T0 i.e. control seeds and for T1 i.e. seeds soaked in water at room temperature for 24 hours). This was 44 days (day 2 to day 45) and 21 days (2 to day 22) for seeds soaked in boiling water (T2) are recorded from.

- A third phase characterised by a stage indicating a germination stop (stationary phase) of each pre-germination treatment.

#### *Effects of pre-germination treatments and origin on the mean germination time (MGT)*

The MGT expresses the time required for half (50%) of the seeds to germinate (T50) (Table 1). The lowest MGT was observed from NS with T2 treatment, followed by NS with T0 treatment. T0 treatment for SS had a MGT of 14.09 days. T1 treatment for NS and SS provenances had a MGT of 14.47 and 17.63 days. T0 treatment for SS did not achieve a 50% germination rate.

Table 1. data on the rate of germination and the mean germination time

Treatment	Germination rate (%)		Mean germination time (days)	
	North-Sudanian	South-Sudanian	North-Sudanian	South-Sudanian
T0	96	79	9,28	14,09
T1	90	67	14,47	17,63
T2	59	49	7,25	-

Provenances	Treatments	Germination rate	Mean germination time (days)
North-Sudanian	T0	96%	9,28
	T1	90%	14,47
	T2	59%	7,25
South-Sudanian	T0	79%	14,09
	T1	67%	17,63
	T2	49%	-

### *Effects of germination pre-germination treatments and provenance on seedling growth*

#### Monitoring the height growth of seedlings in the nursery

In the NS provenance, the height growth of plants from T0 is slightly higher than that of the other two treatments. For SS provenance, plants from T0 and T2 have almost identical height growth, while those from T1 have the lowest height growth.

Concerning the analysis of variance, it revealed that the provenance had no significant influence on the height growth of the seedlings ( $P = 0.684$ ) at the 5% threshold. The mean height value shows that the plants from both provenances are identical for the Tukey test at the 5% threshold (Table 2). In contrast to provenance, the effect of germ pre-germination treatment revealed a very highly significant difference ( $P = 0.000$ ) for height. Thus, the mean value for height shows that the plants in the control treatment (T0) are higher than T1 and T2, while T1 and T2 are identical to the Tukey test (Table 2) at the 5% threshold.

Table 2. comparison of Tukey for height growth based on provenance and pre-germination treatment at the 5% threshold

		Mean ± Standard deviation
<b>Provenances</b>	NS	20.72 ± 13.63a
	SS	20.43 ± 14.64a
<b>Pre-germination treatment</b>	T0	22.62 ± 14.53 a
	T1	20.04 ± 13.57b
	T2	19.06 ± 14.09b

*Averages that do not share any letters are significantly different*

#### Diameter growth dynamics

The growth in diameter of the seedlings from the seeds from NS shows that the growth in diameter of T0 remained higher than the other two treatments during the period of the experiment. The plants from T1 and T2 seed had not significantly different average diameters during the first week, and from the second week until the end of the trial, the average diameter of T1 plants became larger and larger than that of T2. As for SS provenance, the average diameter of the plants from the T0 treatment remained larger during the experiment. It is followed, respectively by those of T2 and then T1.

Table 3. comparison of Tukey for diameter growth by provenance and pre-germination treatment at the 5% threshold

		Mean ± Standard deviation
<b>Provenances</b>	NS	2.56 ± 1.01a
	SS	2.35 ± 1.11b
<b>Pre-germination treatment</b>	T0	2.68 ± 0.93a
	T1	2.38 ± 1.19b
	T2	2.30 ± 1.02b

*Averages that do not share any letters are significantly different*

The analysis of variance showed that the effect of provenance on the growth in seedling diameter is significantly different ( $P=0.02$ ). As for the ANOVA of the effect of the different pre-germination treatments on plant diameter growth, it was found to be highly significant ( $P=0.000$ ). The mean diameter value in the Tukey test shows that T0 is greater than T1 and T2. While there is not significant different between T1 and T2 (Table 3).

## Leaves production

The results show that the plants from the three NS provenance treatments had approximately the same number of leaves during the monitoring period. In contrast, plants from SS provenance; T2 plants had the most leaves, followed by those from T0 and T1. This difference becomes greater towards the last weeks.

Table 4. Comparison of Tukey for leaf production based on provenance and pre-germination treatment at the 5% threshold

		<b>Mean ± Standard deviation</b>
<b>Provenances</b>	NS	11.599 ± 6.10a
	SS	9.781 ± 5.23b
<b>Pre-germination treatment</b>	T0	11.167 ± 5.43a
	T1	11.009 ± 5.83a
	T2	9.894 ± 5.92b

*Averages that do not share any letters are significantly different*

With regard to ANOVA on leaf production, a highly significant difference ( $P=0.000$ ) was revealed for each provenance. For the mean value of the leaves, the Tukey test for both provenances showed that the NS provenance produced more leaves than the SS provenance (Table 4). As for the germ pre-germination treatment effect on leaf production, the analysis of variance revealed a highly significant difference ( $P=0.000$ ). Tukey's 5% threshold test (Table 4) for the mean leaf value shows that T0 and T1 are not significantly different. On the other hand T2 produces fewer leaves than T0 and T1.

## Branching of the plants

For both origins, a very strong branching of the seedlings was observed. In fact, 64.44% of the seedlings from NS provenance branched compared to 53.33% from SS provenance. With regard to the level of positioning of the branching on the stem, 96.66% of seedlings from NS provenance branched at the basal position compared to 21.62% from SS provenance.

Table 5. Comparison of Tukey for branching by provenance and pre-germination treatment at the 5% threshold

		Mean ± Standard deviation
<b>Provenances</b>	NS	0.47 ± 0.89a
	SS	0.30 ± 0.82b
<b>Pre-germination treatment</b>	T0	0.47 ± 1.00a
	T1	0.37 ± 0.85ab
	T2	0.32 ± 0.70 b

*Averages that do not share any letters are significantly different*

The analysis of variance carried out for the two provenances revealed a highly significant difference ( $P=0.000$ ). Thus, the comparison of the mean values with the Tukey test (Table 5) at the 5% threshold revealed that the NS provenance produces more ramifications than the SS provenance. For seed pre-germination treatments, the effect on branching was found to be significant ( $P=0.016$ ) at 5%. The Tukey test at the 5% threshold (Table 5) showed that T2 pre-germination treatment is superior to T0 and T1. Whereas T1 and T0 are not significantly different. Photo 4 shows an example of branching patterns for the seedlings during the test.

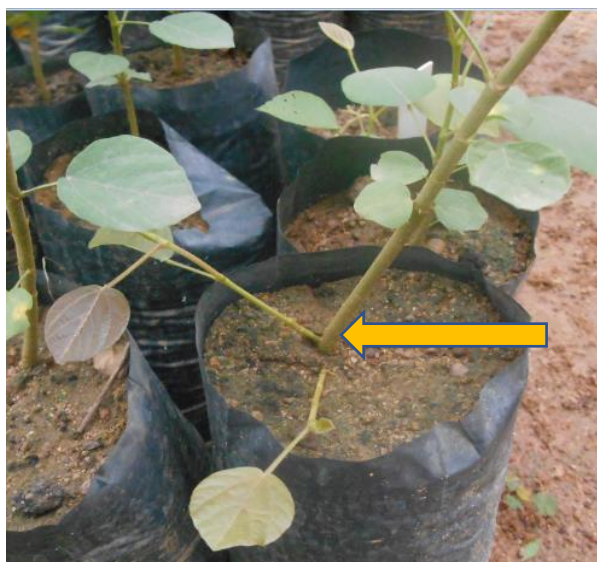


Photo 4. Branching patterns for the seedlings

#### *Seedling survival rate*

For both origins, we obtained 100% survival rate for T0. For the SS provenance, 100% of seeds soaked in boiling water (T2) survived while seeds soaked in ambient tap water (T1) gave had a survival rate of 83.33%. For the NS provenance the survival rate of T1 and T2 were 96.66% and 93.33% respectively.

#### 4. Discussion

Seed maturation on mother tree usually ends with very strong dehydration. The moisture contents calculated for seeds from the two provenances was less than 10%. This is enough to maintain viability during storage of orthodox seeds (Bonner, 2008). According to Dedi and Allou (2015), small seeds contain little water with slowed enzymatic reactions, so they can be stored well and therefore only need to be supplied with water for the slowed life to cease.

The study showed a variation in germination performance depending on the seed origin and the pre-germination treatments applied. The group of seeds that did not receive any pre-germination treatment (control, T0), had the highest germination capacity in each provenance (96% for NS and 79% for SS) compared to the pre-germination treatments T1 and T2. This could be explained by the fact that seeds of *F. faginea* have a good germination capacity and therefore do not suffer from dormancy problems. Moreover, the fact that the seeds were not leached implies that the concentration of gibberellin would have been higher than that of abscisic acid. This, combined with the favourable environment tailored to improve the germination process may have led to the superior results obtained by T0 (Carvalho *et al.*, 2016). Contrary to our results, studies on other legumes such as *Parkia biglobosa* Benth. (FAO, 1992), *Pterocarpus erinaceus* Poir (Bamba *et al.*, 2018) and on *Prosopis africana* (Guill. & Perr.) Taub. (Ahoton *et al.*, 2009; Laouali *et al.*, 2015) showed that pre-germination treatment is prerequisite to achieving high germination rates. Furthermore, these results confirm those of Houehounha *et al.*, (2009) and also Djigbodjefe and Ouinsavi (2019) respectively on the germination of *Daniellia oliveri* (Rolfe) Hutchison and Dalziel and *Abrus precatorius* Linn. seeds.

The latency time (1 day) was short and did not differ by treatments used. Therefore, pre-germination treatments and provenance did not influence the latency time. These results contradict the work of Dardour *et al.*, (2014) on *Brachychiton acerifolius* (Schott & Endl.) R.Br. whose pre-germination treatments reduced the latency time. Seeds from the NS provenance were found to have the best performance in terms of latency, GMT and germination percentage compared to seeds from the south Sudanese (SS) provenance. These differences in germination rate between NS and SS provenance could be partly explained by the poor quality of some seeds from the SS provenance. Such results therefore suggest that seeds of NS provenance are preferable for the production of *F. faginea* plants in nurseries. Similar results were obtained by Yameogo (2018) with *Securidaca longepedunculata* Fres. and by Ado *et al.*, (2017) with *Diospyros mespiliformis* Hochst. Ex A.DC which also showed a significant effect of provenance on seeds germination.

Germination takes 6-8 weeks for untreated (T0) and water-soaked seeds at room temperature. This germination staggering is thought to be due to differential dormancy (FAO, 1992; Moupela *et al.*, 2013), a species' adaptation strategy to variations in rainfall (Ouedraogo, 2006). This survival strategy is relatively common in dense tropical rainforests (Moupela *et al.*, 2013). The treatment with tap water at room temperature obtained germination rates that were similar to that of the control. However, this pre-germination treatment did not reduce the MGT. The effect of soaking *Brachychiton populneus* in tap water has already been

reported in the literature (Schott & Endl.) and in general by Dardour *et al.*, (2014) According to the FAO in 1992, soaking in water allows leaching of chemical inhibitors that are involved in physiological dormancy. As for boiling pre-germination treatment, the results give the fastest germination time and lowest rate of germination percentage and MGT than all other treatments. The lower MGT could be explained by the fact that boiling water causes cracks in the seed coat, allowing the seed to soften and sufficient water and oxygen to pass through the seed (Dardour *et al.*, 2014), which accelerates germination. For T2, low germination rates are thought to be due to seed sensitivity to heat (Zerbo *et al.*, 2010); or to germ asphyxiation (Dardour *et al.*, 2014) caused by excess water entering the seed through cracks created by thermal shock. This results in the death of the embryo germ (Zerbo *et al.*, 2010; Bamba *et al.*, 2018). Similarly, according to Douma *et al.*, (2019), the exposure of a seed that is not dormant to high temperature for a long period has a lethal effect on it. This may explain the low germination rates obtained by T2.

However, the same pre-germination treatment has been shown to improve germination of seeds of other species such as of *Parkia biglobosa* (FAO, 1992) and *Prosopis africana* (Ahoton *et al.*, 2009). According to Ahoton *et al.*, (2009), the length of time seeds are soaked in boiling water depends on the thickness and hardness of the seed coat. Using boiling water is preferable for thicker and harder seeds coat (Gama-Arachchige *et al.*, 2013b). Overall, the most effective treatment to trigger the germination process of *F. faginea* was the T0 control test.

As regards the morphological development of *F. faginea* in the nursery, results of the ANOVA test comparing pre-germination treatments revealed differences in growth parameters depending on the origin of the seeds for all parameters except the seedling height. The NS provenance recorded the best growth in diameter, branching and leaves production. These differences could partly be explained by a lack of adaptation of the seedlings of the SS provenance in the NS zone leading the seedlings to behave differently. The SS zone is a high rainfall area and the species probably acquired the ability to minimize diametric growth, leaf and branch production; and to grow faster in height, in competition with other species for environmental factors. Tandjiékpon and Dah-Dovononon (1999) and Kafando (2016) also found a significant effect of provenance on the growth of seedlings of *Acacia auriculiformis* A. Cunn. ex Benth. and *Prosopis Africana*, respectively. Results of ANOVA also illustrated that the growth performance of the seedlings matched their germination trend.

The average stem height, diameter and number of leaves values of T0 were higher than T1 and T2. This indicates that growth hormones were leached out by soaking in water (T1 and T2) and more concentrated in the seedlings from untreated seeds. These results are in opposition with those obtained by other authors (Douma *et al.*, 2019; Djigbodjafé and Ouinsavi, 2019; Lompo *et al.*, 2019), who showing that seed pre-germination treatment is needed to stimulate growth initial of the seedlings. Similarly, N'Danikou *et al.*, (2014) pointed out that even if a seed quality has been sown on fertile soil with water supply, the vigour of the seedling will be affected by the time taken by the seed to germinate. In this case, the seed embryo is weakened over time if germination takes longer time than normal. The growth of the seedlings in the nursery was very fast. This would probably be due to the

favourable temperature (29.38°C) and humidity (68.74%), the substrates provided and the production period of the plants. These results support those of Nguema *et al.*, (2013) who found similar results on *Jatropha curcas* showing that seed regeneration of the plants shows rapid growth.

As regards the survival rate of seedlings in *F. faginea* nurseries, the control treatment (T0) superseded other pre-germination treatments. However, the leaves of some plants were probably attacked by insects. Generally, for most of the local plant species in Burkina Faso, seedlings produced in the nursery range from 15 to 30 cm in height. Therefore, after two to three months of growing in the nursery, seedlings obtained by sexual reproduction can be planted in the fields.

## 5. Conclusion

The present study provided information on the reproductive capacity and growth different seeds of *Flemingia faginea* from Burkina Faso. Based on these results, the sustenance of *F. faginea* is possible through seed propagation.

The germination characteristics of *F. faginea* seeds showed that its' seeds are not dormant. The untreated (control) seeds had the best germination capacity and the best potential in growth and survival. The North-Sudanian provenance was the preferred area for seed collection for optimal germination capacity and growth with plant vigour and good branching.

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