Journal of Applied Biosciences 199: 21006 - 21022
ISSN 1997-5902

Effect of seed treatments on germination and nursery growth of three multipurpose and priority trees for domestication from Miombo woodlands of the Democratic Republic of the Congo.

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Submission 27th May 2024. Published online at https://www.m.elewa.org/Journals/ on 31st August 2024.
https://doi.org/10.35759/JABs.199.2

ABSTRACT

Objective: The aim of this study was to evaluate the influence of different dormancy-breaking treatments on the germination of *Strychnos cocculoïdes* (Oranger d'Afrique, Monkey orange or Kisongole), *Uapaca kirkiana* (Masuku or sucre de prune) and *Sclerocarya birrea* (Marula or Muhongo), three multipurpose Miombo species of high priority for domestication.

Methodology and Results: For *U. kirkiana* and *S. birrea*, seeds were divided into four treatments i) manual scarification of the seed coat with a hammer; ii) soaking in tap water at room temperature for 72 hours; iii) soaking in boiling water until cooled, and iv) untreated control. In *S. cocculoïdes* particularly, the seeds were: i) sun-dried for 72 hours (treatment 1-T1); ii) soaked in tap water at room temperature for 72 hours (T2); iii) soaked in boiling water until cooled (T3), and iv) untreated (control). A very high germination rates was found in *U. kirkiana* and *S. cocculoïdes* seeds (over 90%), irrespective of the dormancy-breaking treatments applied. In *S.*

birrea, while germination was significantly influenced by the dormancy-breaking treatments applied to the seeds. Soaking the seeds in boiling water until cooling resulted in the highest germination rate (68±7%). Manual scarification was the least effective (24±6%) treatment. The average time to obtained a germination was relatively shorter for *S. birrea* (12±3 days), but very long for *S. cocculoïdes* (45±4 days). In *U. kirkiana*, the lag time is around 20 days.
*Conclusion and Application of Results***:** For best results with *S. cocculoïdes* and *U. kirkiana*, we recommend using freshly harvested seeds, even without dormancy-breaking treatments. In the case of *S. birrea*, however, seeds soaked in boiling water were the most effective. Field monitoring over a long observation period would enable us to assess the ability of these species to grow and develop under ex situ conditions. Vegetative propagation tests could also be envisaged.
Keywords: Miombo, multipurpose trees, domestication, agroforestry, DR Congo.

RÉSUMÉ

*Objectif***:** De la présente étude était d'évaluer l'influence des différents traitements de levée de dormance sur la germination de *Strychnos cocculoïdes* (Oranger d'Afrique, Monkey orange ou Kisongole), *Uapaca kirkiana* (Masuku ou sucre de prune) et *Sclerocarya birrea* (Marula ou Muhongo) trois espèces de Miombo à usages multiples prioritaires pour la domestication.
Methodologie et resultants **:** Chez *U. kirkiana* et *S. birrea*, les graines ont été réparties en quatre lots de traitement de levee de dormance : i) scarification manuelle du tégument à l'aide d'un marteau, ii) trempage dans l'eau de robinet à température ambiante pendant 72 heures, iii) trempage dans l'eau bouillante jusqu'au refroidissement et iv) témoin non traité. Chez *S. cocculoïdes*, les traitements étaient les suivants : i) séchage des graines au soleil pendant 72 heures, ii) trempage dans l'eau de robinet à température ambiante pendant 72 heures, iii) trempage dans l'eau bouillante jusqu'au refroidissement et iv) témoin non traité. Les résultats obtenus ont permis d'enregistrer des taux de germination très élevés chez *U. kirkiana* et *S. cocculoïdes* (plus 90%), indépendamment de traitements de levée de dormance appliqués aux graines. Par contre chez *S. birrea,* la germination a été significativement influencée par les traitements de levée de dormance appliqués aux graines. Le trempage des graines dans l'eau bouillante jusqu'au refroidissement a permis d'obtenir le taux de levée le plus élevé (68±7%). La scarification manuelle s'est avérée moins performante (24±6%). Le temps moyen pour obtenir une germination était relativement plus court chez *S. birrea* (12±3 jours), mais très long chez *S. cocculoïdes* (45±4 jours). Chez *U. kirkiana*, le temps de latence est d'environ 20 jours.
Conclusion et application des résultats **:** Pour obtenir les meilleurs résultats chez *S. cocculoïdes* et *U. kirkiana*, il est récommandé d'utiliser les graines fraichement récoltées même sans recours aux traitements de levee de dormance. Par contre chez *S. birrea* les graines trempées dans l'eau bouillante ont été les plus performantes. Le suivi en plein champ, pendant une longue période d'observation permettrait d'évaluer l'aptitude de ces espèces à croitre et à se developer en conditions ex situ. Mais aussi, des tests de multiplication vegetative sont à envisager.
Mots clés : Miombo, domestication, espèce agroforestière, plante médicinale, plante fruitière, Haut-Katanga.

INTRODUCTION

In southern Africa, Miombo woodlands directly supports the lives of over 100 million people in rural and urban areas by providing them with a variety of products and ecosystem services (Atangana and Khasa, 2014; Blakie *et al.,* 2014; Waeber *et al.,* 2012). Trade of Miombo products contributes to the household economy and to improving the living conditions of local populations (Betti, 2002; Packham, 1993). In the Katanga region, in the south-east of the Democratic Republic of Congo (DRC), Miombo is the most dominant forest formation (Potapov *et al.,* 2012 ;). Almost the entire human population of Katanga relies on traditional medicine for their health (Mutombo *et al.,* 2022; Bakari *et al.,* 2017), with massive use of woody plants harvested exclusively in the wild (Ndaye *et al.,* 2024; Mujike *et al.,* 2023). This heavy reliance on traditional medicine is mainly justified by the extreme poverty of local populations, the high cost of modern medicine and the socio-cultural preferences or habits (Mavungu *et al.,* 2023; Mutombo *et al.,* 2022; Bakari *et al.,* 2017). In addition to the use of Miombo species in traditional human and animal medicine, non-timber forest products are also used as food (Kirongozi *et al.,* 2023; Kanga *et al.,* 2021; 2018; Bomolo *et al.,* 2019; Packham, 1993; Malaisse, 1997). In addition, the main, if not the only, source of energy wood (Péroches *et al.,* 2021). However, despite the important goods and services provided by Miombo, the combined effects of human population growth and very high anthropogenic pressure leads Miombo to shrink dramatically and alarmingly (Muteya *et al.,* 2023; Muchiza *et al.,* 2022; Cabala *et al.,* 2018; Useni *et al.,* 2017; Blackie *et al.,* 2014; Potapov *et al.,* 2012). This situation results in the rarefaction and even disappearance of the most important plant species, including medicinal and fruit trees (Mujike *et al.,* 2023; Nkulu *et al.,* 2022), leading to deterioration in the living conditions of the people who depend on these resources. In this context, and in order to avoid the worst, strategies to conserve and sustainably manage Miombo trees need to be urgently developed. Domestication has been shown to be one of the most promising solutions to the unsustainable management of natural resources, as it not only reduces pressure on wild populations, but also ensures a supply of products from these species (Mujike *et al.,* 2023; Leakey, 2012; Simons and Leakey, 2004). However, the lack of information on the propagation of these wild species is a major constraint to domestication projects (Mujike *et al.,* 2023; Gbenato *et al.,* 2014). *Sclerocarya birrea*, *Strychnos cocculoïdes* and *Uapaca kirkiana* are among the priority multipurpose species for domestication in the Miombo region (Tanga *et al.,* 2018; Hamilton, 2003; Franzel *et al.,* 1996). These species are well known to local populations for their use as food. Their highly prized fruits are sold on local and regional markets (Malaisse, 1997; Franzel *et al.,* 1996; Packham, 1993). They are also widely used in traditional medicine to treat various illnesses (Séné *et al.,* 2018; Meerts and Hasson, 2016; Maroyi, 2013; Orwa *et al.,* 2009; Vwakyanakazi and Petit, 2004). In neighbouring regions of Miombo woodland of southern Africa, these species are already being domesticated (Akinifeshi *et al.,* 2008; 2006; Leakey *et al.,* 2005). In DRC, these species are still harvested exclusively in the wild, and studies for their domestication are almost non-existent. This study aims to assess the suitability for generative propagation of these species of great socio-economic interest. More specifically, it tests the influence of dormancy-lifting treatments on seed germination and growth of *S. birrea*, *S. cocculoïdes* and *U. kirkiana* under nursery conditions. The following section gives more details about the study location and environment.

MATERIALS AND METHODS

Environment: The experiment was conducted on nursery in the experimental garden of the Faculty of Agronomic Sciences (FAS) of the University of Lubumbashi (UNILU), in Lubumbashi (E27°48'61", S11° 61'55, 3''; and 1257m in altitude). Lubumbashi is under a Cw6 Köppen's climate classification, with a five-month rainy season, lasting from November to March and a marked dry season, from May to September. April and October are considered as transition months (Ngongo *et al.,* 2009). The average annual temperature is 20°C and average annual rainfall is 1,200 mm. The Lubumbashi region is dominated by the ferralsol soil type (Mujinya *et al.*, 2013; Ngongo *et al.*, 2009). The most common vegetation is the Miombo forest, a tropical dry forest dominated by three leguminous genera of the Caesalpinioideae subfamily, namely *Brachystegia*, *Julbernardia* and *Isoberlinia* (Campbell *et al.*, 2007). Industrial and artisanal mining and slash-and-burn agriculture are the main activities of the region.

Presentation of the species studied: *S. birrea* is a dioecious tree in the Anacardiaceae family, reaching 9-12 m in height. Leaves are alternate, 8-38 cm long, imparipinnate with 3-18 pairs of leaflets (Mutshinyalo and Tshisevhe, 2003). The fruit is a mature yellow drupe with thick skin, fibrous mesocarp, fleshy and juicy. The seeds are obclavate, compressed, 15-20 mm × 4-8 mm × 2.5 mm, with a brownish papyraceous tegument. The species is multi-purpose, being used as a medicinal plant in the traditional treatment of urinary tract infections, pallia, stomach aches and so on. In addition to medicinal use, it is also a food plant, identified as the first priority local fruit species for domestication in Southern Africa (Franzel *et al.,* 1996). Fermentation of the fruit produces an alcoholic beverage (marula beer). The fruit is also used to make a liqueur, Amarula (Meerts and Hasson, 2016).

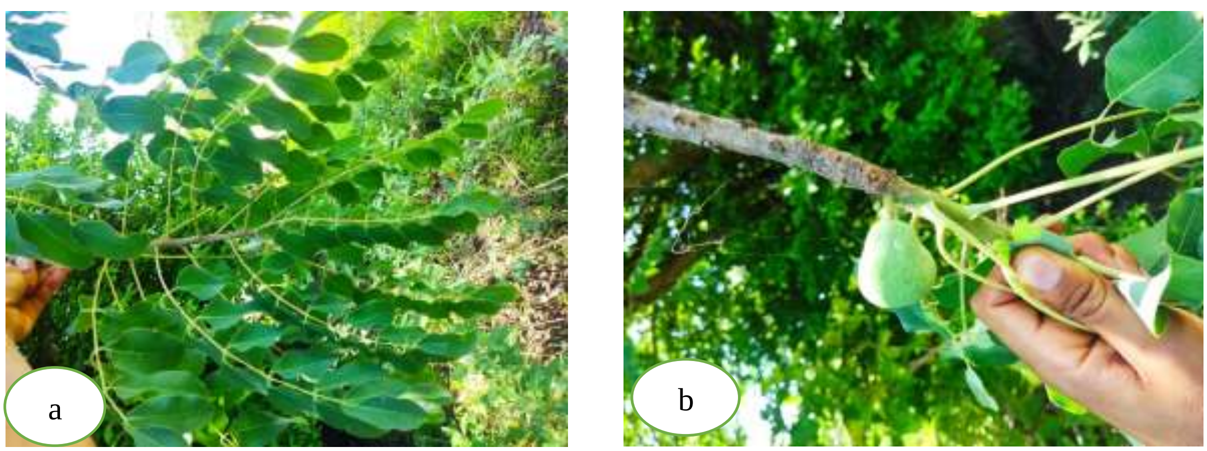

Figure 1: Branch with leaves (a), branch with fruit (b) of *S. birrea* (Photo, Mujike 2023).

S. cocculoides is a shrub of the Loganiaceae family reaching up to 8m in height. The crown is compact and rounded; bark thick, creamy-brown, woody and longitudinally ridged. Spines are strong, pointed and curved towards the base. Leaves are opposite, coriaceous, oblong, elliptical to broadly oval, 1.8-8 x 1.4-6 cm in size (Orwa *et al.,* 2009). The fruit is edible, and its soft wood is used to make handles, pestles, mortars and as a building material. Its roots are used in traditional medicine to treat abdominal pain, male infertility, malaria, etc. (Maroyi, 2013).

Figure 2: *S. cocculoïdes* tree in an agricultural fallow (Photo Mujike, 2023).

U. kirkiana is a small tree in the Phyllantaceae family, growing up to 12 m tall. The branches are spreading, forming a rounded, dancing crown. Leaves are simple, alternate and arranged at the tips of the branches. The trunk is short and robust with thick, deeply fissured dark-gray or gray-brown bark (Meerts and Hasson, 2016). The species is dioecious, with flowers in dense clusters. Fruits are rounded with leathery, yellow-brown skin, up to 3.3 cm in diameter. They contain 3-4 white seeds, 2 cm long and 1.3 cm thick (Orwa *et al.,* 2009). The fruit is edible and sold in local and regional markets (Armistice *et al.*, 2020). The species is also used in traditional medicine to treat various illnesses, notably indigestion and dysentery (Orwa *et al.,* 2009).

Figure 3: Branch with fruit and branch with leaves of *Uapaca kirkiana* (Photo, Mujike 2023).

Biological material: Seeds of these three species (*S. birrea, S. cocculoïdes* and *U. kirkiana*) are the biological material used in this experiment. The *U. kirkiana* seeds were collected at Mikembo (E27°40'3.02", S11° 28'29.14"; altitude 1230m), in the Lubumbashi region of Haut-Katanga province, but those of *S. birrea* and *S. cocculoïdes* came from Haut-Lomami province in the localities of Mabwe (E26°50’85.43’’, S8°65’24.74’’) and Kamina (E24°52’26.1’’, S8°44’24.7’’; altitude 1103m), respectively. All the seeds were harvested from vigorous individuals. Their average diameter at breast height (DBH) was 15-20 cm. Ten trees per species, sufficiently far apart (between 100 and 200 m), were selected to harvest twenty ripe fruits per individual. After harvesting, the fruits were sorted to select seeds of superior quality and uniform size. Mature fruits were recognized by the yellowish colour of their epicarp. Before sowing, *U. kirkiana* and *S. cocculoïdes* seeds were carefully extracted from their fruits. The fruits of *S. birrea* were pulped to obtain a pit.

Experimental design: Seeds were divided into four dormancy-breaking batches (treatments). For *U. kirkiana* and *S. birrea*, the treatments were: i) manual scarification of the seed coat with a hammer; ii) soaking in tap water at room temperature for 72 hours; iii) soaking in boiling water until cooled, and iv) untreated control. In *S. cocculoïdes* particularly, the seeds were: i) sun-dried for 72 hours (treatment 1-T1); ii) soaked in tap water at room temperature for 72 hours (T2); iii) soaked in boiling water until cooled (T3), and iv) untreated (control). The seeds of *S. cocculoïdes* have not been manually scarified, as they are not covered by the hard endocarp.

The experiment was conducted in a randomized design with four dormancy-breaking treatments repeated fifteen times for each species. Seeds were sown in 16 cm x 21 cm black polyethylene bags, with 3 seeds per pot at a depth of around 2 cm. We have increased the number of replicates to improve the precision of our results. The bags, with holes drilled towards the base to ensure good water drainage, were placed in a straight line under a 75 % shade canopy. Forest soil (rich in organic matter) taken from the arboretum of the FAS was used as the growing substrate. Maintenance consisted mainly of weeding (twice a month) and watering once a day with 20 cl of water per plant. For a five-month period (between September 2022 and January 2023) we observed and monitored the following parameters: emergence rate (number of seeds emerged out of the total number of seeds sown, multiplied by 100), lag time (average time after which the first germination is observed), germination duration (period between the first and last germination), number of leaves per plant and plant height.

Statistical analysis: An Analysis of Variance (ANOVA) was performed to test the effect of different treatments on plant emergence and growth in the nursery. In order to respect the normality and homogeneity of the variance of the residuals, the data for lag time, germination time, number of leaves and plant height were Log10 transformed. Those expressed as percentages were transformed into square roots. The method used to discriminate means was the Tukey HSD test with R software version x 64.4.0.5, based on the smallest significant difference at the 5% probability threshold. Log10 and square-root transformation of the data meant that non-parametric tests were not used.

RESULTS

Emergence rate: A very high emergence rate (over 90%) was observed in *U. kirkiana* and *S. cocculoïdes*. More specifically, the highest emergence rate in *U. kirkiana* was recorded with scarified seeds (100±0 %), the lowest with seeds soaked in water at room temperature for 72 hours (86±12 %). Control seeds and those soaked in boiling water until cooled recorded an intermediate rate at both ends (94±5 %). ANOVA showed no significant difference between treatments ($p>0.05$). For *S. cocculoïdes*, the highest rate was obtained with the seeds soaked in boiling water until cooling and with control seeds (95±3 %), followed by those sun-dried for 72 hours (92±5 %). The seeds soaked in water at room temperature recorded the lowest emergence rate (90±5 %). ANOVA showed no significant difference ($p>0.05$). In *S. birrea*, the best emergence rate was obtained with soaking in boiling water until cooling (68±7 %). The lowest with scarified seeds (24±6 %). Seeds soaked in water at room temperature and controls recorded intermediate emergence rates at both ends (59±5 % and 45±4 % respectively). ANOVA showed a significant influence of treatments on the emergence rate (p=0,001). Figure 4 below schematically illustrates the influence of treatments on *S. cocculoïdes, S. birrea* and *U. kirkiana* germination.

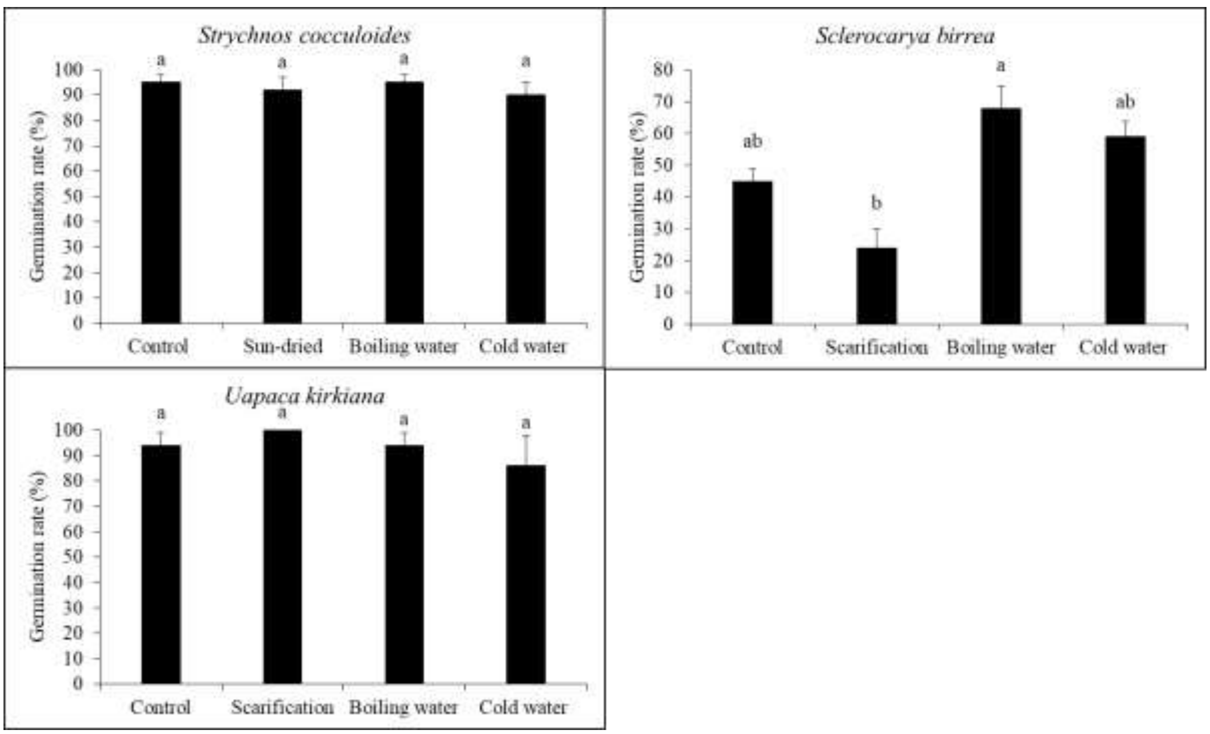

Figure 4: Influence of treatments on germination of *S. cocculoïdes, S. birrea* and *U. kirkiana*.
a, b, c: values with the same letters are not significantly different at the 5% probability threshold of Tukey's test.

Lag time: The average time to emergence for *U. kirkiana* is around 20 days for all the treatments combined. It is highest with control seeds (22±6 days), followed by seeds soaked in water at room temperature for 72 hours (20±4 days). Scarified seeds and those soaked in boiling water until cooled germinated after 19±5 days. ANOVA showed no significant difference ($p>0.05$). With *S. cocculoïdes*, the latency period is generally longer (over 40 days). More specifically, the results show that sun-drying the seeds for three days delayed germination (45±4 days). Control seeds and those soaked in water at room temperature for 72 hours had a lag time of 42±6 days. Seeds soaked in boiling water until cooled had an average lag time of 43±7 days. ANOVA showed no significant difference (p>0.05). For *S. birrea*, the highest lag time was 17±2 days, observed respectively with seeds soaked in boiling water until cooling and control seeds. Seeds soaked in water at room temperature for 72 hours and scarified seeds germinated early (14±2 days and 12±3 days respectively). ANOVA showed no difference between these treatments (p>0.05). Figure 5 below schematically illustrates the influence of treatments on *S. cocculoïdes*, *S. birrea* and *U. kirkiana* lag time.

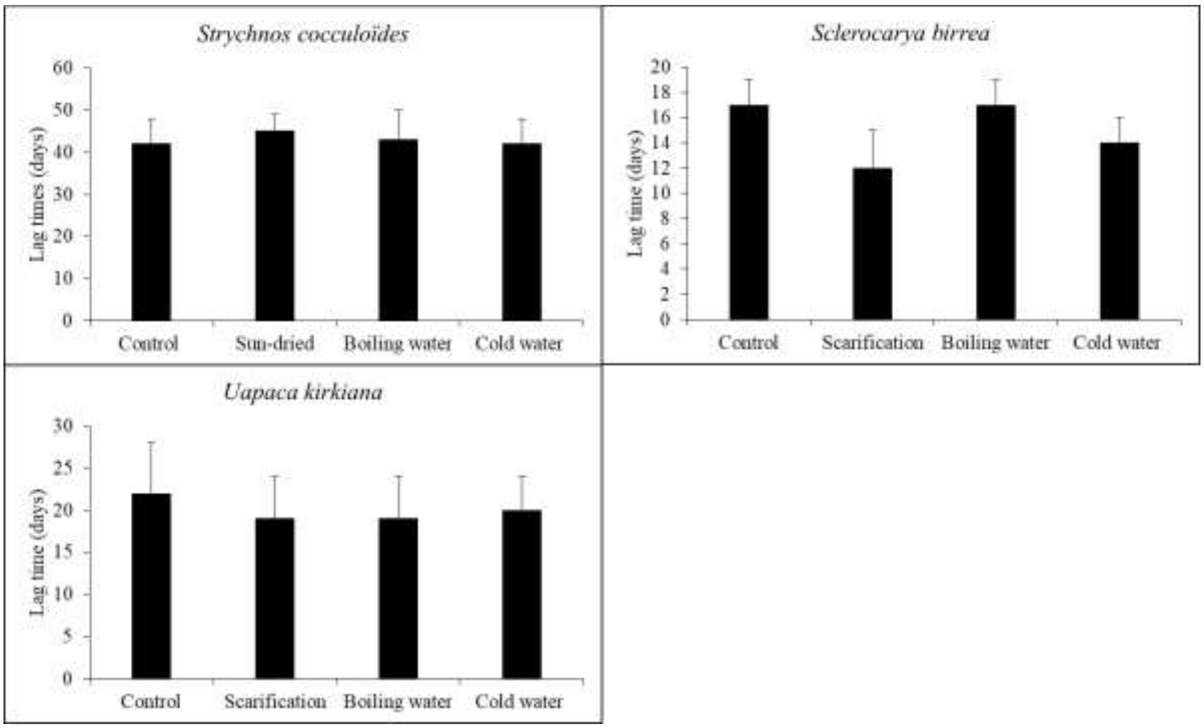

Figure 5: Influence of treatments on lag time of *S. cocculoïdes*, *S. birrea* and *U. kirkiana*.

Germination duration: The longest germination time of *U. kirkiana* seeds, was obtained with control seeds (30 days), while the shortest was with scarified seeds (two weeks). Soaking seeds in boiling water and in water at room temperature resulted in germination times of over three weeks. ANOVA showed a significant difference between treatments (p=0.041). In *S. cocculoïdes*, germination duration was 19±2 days, with seeds soaked in water at room temperature for 72 hours, followed by seeds sun-dried for three days and those soaked in boiling water until cooled (16±1 and 16±4 days, respectively). Germination time was shorter with control seeds (13±3 days). ANOVA showed no significant difference (p>0.05). For *S. birrea*, the longest germination time was 19±5 days, with seeds soaked in boiling water until cooling. The shortest was with control seeds (9±1 days). Seeds soaked in water at room temperature for 72 hours and those scarified took 14±1 days and 12±4 days, respectively. ANOVA showed significant differences (p<0.05). Following, Figure 6 schematically illustrates the influence of treatments on the germination time of *S. cocculoïdes, S. birrea* and *U. kirkiana*.

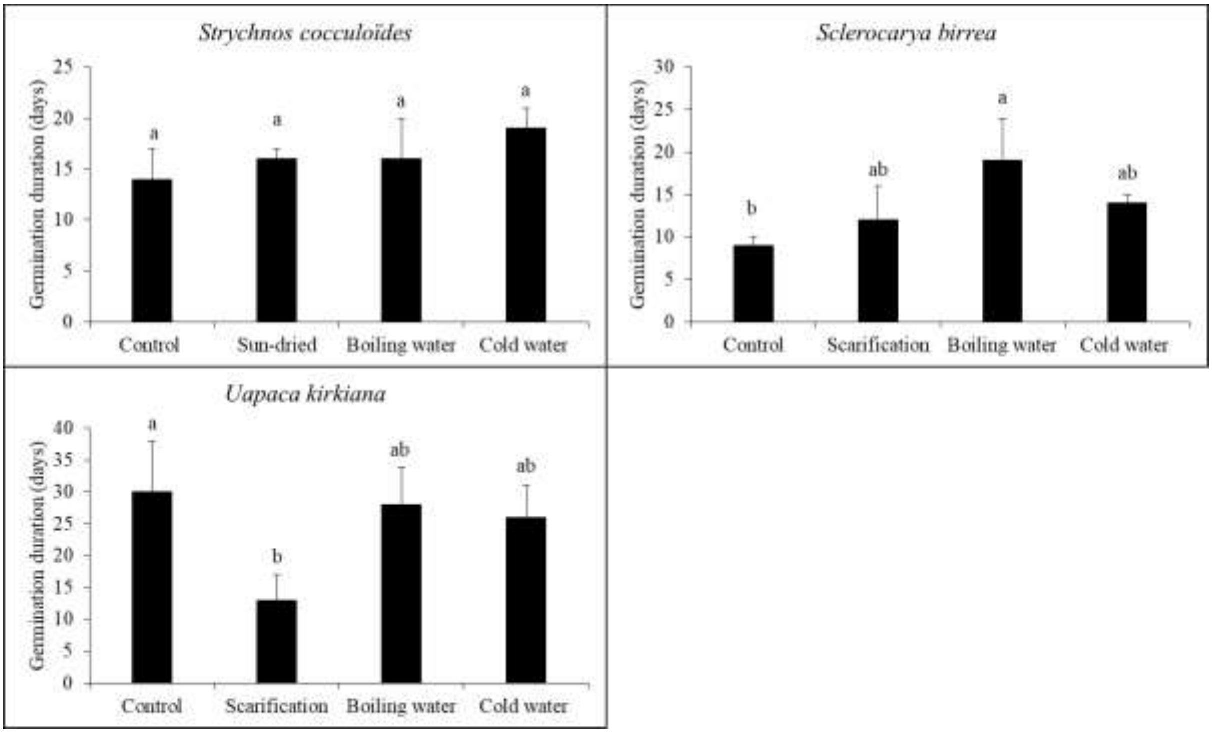

Figure 6: Influence of treatments on duration germination of *S. cocculoïdes*, *S. birrea* and *U. kirkiana*. a, b, c: values sharing with the same letters are not significantly different at the 5% probability threshold of Tukey's test.

Number of leaves: Regarding the number of leaves per plant, *U. kirkiana* showed the highest number of leaves (10±2 leaves) with scarified seeds and the lowest (8±1) for controls. Seeds soaked in ambient water and those soaked in boiling water recorded 9±1 leaves per plant. No significant difference was observed ($p > 0.05$). In *S. cocculoïdes*, seeds soaked in boiling water produced the highest number of leaves per plant (25±1), followed by seeds soaked in water at room temperature (22±1). Control and sun-dried seeds had fewer leaves per plant (20±2). The ANOVA was non-significant ($P > 0.05$). For *S. birrea*, the highest number of leaves was 14±3 with seeds soaked in boiling water, and the lowest was 9±4 with controls. Scarified seeds and those soaked in ambient water showed an intermediate result (12±2 leaves). ANOVA showed no significant difference ($p > 0.05$).

Plant height in the nursery: Results obtained after 5 experiments months show that nursery growth of *S. cocculoïdes* is relatively rapid (27 cm). The tallest plants were recorded with seeds soaked in boiling water (28±1 cm), followed by control seeds and seeds soaked in cold water (27±1 and 26±2cm respectively). Sun-dried seeds obtained 25±3 cm in height. However, the ANOVA was not significant ($p > 0.05$). *S. birrea*, the highest plant height was observed with seeds soaked in water at room temperature (33±7cm). Seeds soaked in boiling water had the shortest plants (20±7cm). Intermediate heights (31±5cm and 30±6cm) were obtained with scarified seeds and controls. ANOVA showed a significant effect of treatments on height ($p<0.05$). Compared with the other two species, *U. kirkiana* was the species with the shortest plants. For this trees, the tallest plants emerged from scarified seeds (11±2 cm), followed by control seeds and those soaked in cold water (10±1 cm). The seeds soaked in boiling water were less tall (9±2 cm). The

ANOVA was not significant (p> 0.05). Figure 7 schematically illustrates the influence of treatments on the nursery height of *S. cocculoïdes, S. birrea* and *U. kirkiana* seedlings.

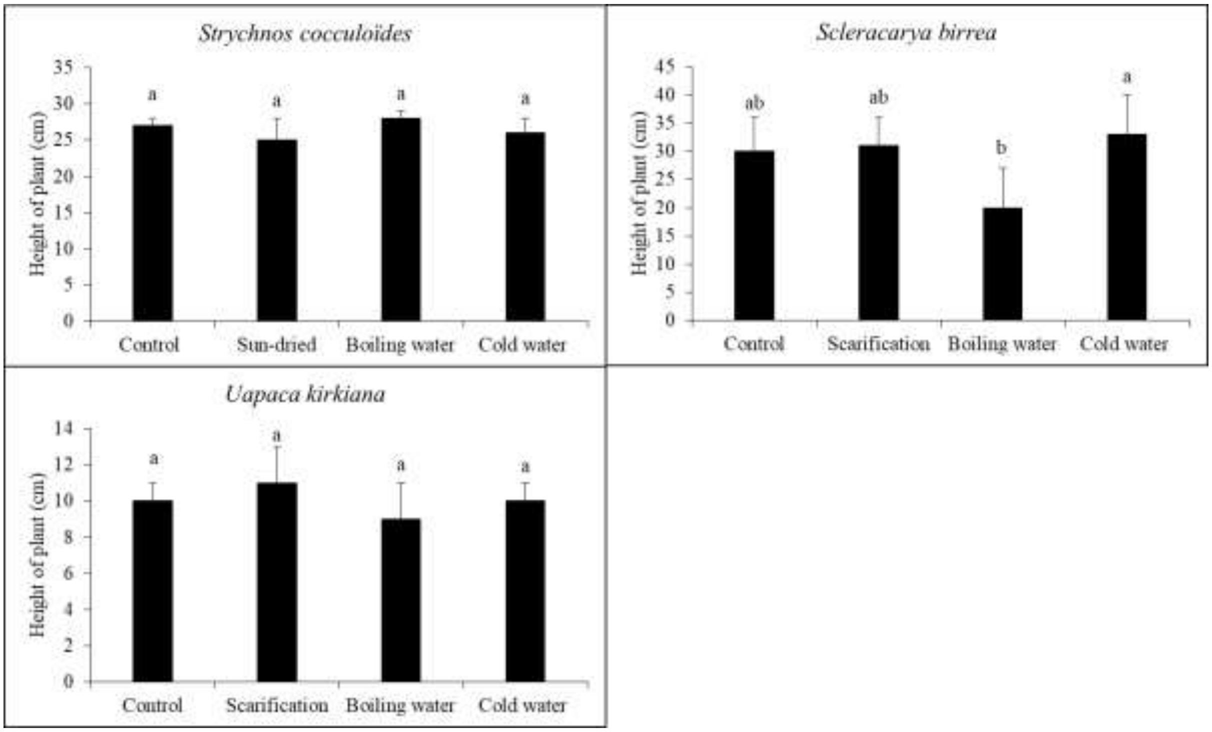

Figure 7: Influence of treatments on *S. cocculoïdes, S. birrea* and *U. kirkiana* height per plant. a, b, c: values with the same letters are not significantly different at the 5% probability threshold of Tukey's test.

DISCUSSION

Influence of treatments on germination: Mastering plant propagation under nursery conditions is a key domestication step for agroforestry species (Mujike, 2022; Atangana and Khasa, 2014; Leakey and Newton, 1994). The propagation techniques tested in this study yielded very interesting results at low cost. There was no significant difference between the dormancy-breaking treatments applied to the seeds of *S. cocculoïdes* and *U. kirkiana*, in contrast with those from Hleni *et al.* (2018) in Namibia and Mulanga (2016) in RDC, where the germination rate of *S. cocculoïdes* was significantly influenced by seed pre-treatments. The 95% emergence rate obtained in this study with *S. cocculoïdes* is far higher than the 38% obtained by Mulanga (2016) on the observation of some growth parameters of *S. cocculoïdes* under Lubumbashi conditions. In Hleni *et al.* (2018), the highest emergence rate was obtained with cold water soaking (70%). The difference in results obtained could be justified by the recalcitrant nature of *S. cocculoïdes* seeds. Indeed, unlike Mulanga (2016) and Hleni *et al*. (2018) who used stored the seeds for a long period (around six months), in this study, experiments consisted in using freshly harvested seeds. The influence of storage time on seed germinability has also been reported by Ado *et al.*, (2017), as well as by Silue *et al.*, (2017) on *Diospyros mespiliformis* and *Isoberlinia spp.* respectively. The emergence rate of *U. kirkiana* obtained in this study is higher than the nearly 65 % from Tshibangu (2012), in

Petri dishes. For *U. guineensis*, Kitambala (2012) and Boyombe *et al.* (2021) also did not obtain greater than or equal (to our study's) emergence rate in the Yangambi region (under wetter and hotter conditions, in north-eastern DRC). The non-significant effect of treatments on the germination of *U. kirkiana* was also recorded by Ngulube *et al.* (1997) on *U. kirkiana* in Malawi, who concluded that without any special treatment, simply washing the seeds with ordinary water was sufficient for successful germination. In the case of *S. birrea*, results showed a significant influence of treatments on seedlings emergence. Soaking the seeds in boiling water until cooled down provided the best results. Garba *et al.* (2020) report that seed germination can be influenced by the technique used to lift dormancy. Soaking seeds in boiling water improved the germination rate of *Prosopsis africana* (Ahoton *et al.,* 2009). This massive germination of seeds soaked in boiling water may be because boiling water softens the seed coat and induces germination. Several other authors confirmed that soaking seeds in boiling water is the best technique for lifting dormancy and inducing germination (Mojermane *et al.,* 2020; Badru *et al.,* 2004). Under certain conditions, regular bush fires, which are an important factor in Miombo woodlands ecology, could influence the regeneration of the species in the wild. Although scarification has the advantage of facilitating water and oxygen penetration into the cotyledons to trigger the germination process, this technique was found to be the least effective in *S. birrea*. Similar results were presented by Yougouda *et al.,* (2020); indicating that, although this technique is effective in improving the germinative power of seeds, it does, however, at times have disadvantages on seed viability, leaving the embryo and cotyledons water- and protein-logged, leading to rotting and parasitic attacks. With regard to lag time, the results showed no significant differences between treatments. This may be explained by the short seed storage time (less than a week) between harvest and sowing. Ahoton *et al.* (2009) and Sanogo *et al.* (2013) show that seed storage can influence different germination parameters. Considering Mensbruge's (1966) classification of seeds in terms of the time required to observe first germination, *U. kirkiana* and *S. birrea* are fast germinating species (species whose seeds germinate between 2 and 6 weeks after sowing). *S. cocculoïdes*, on the other hand, can be considered a slow-germinating species (seeds germinate between 6 and 12 weeks after sowing).

Influence of treatments on plant growth in nurseries: Vegetative parameters (height and number of leaves) determine how long a nursery can be run. The height observed in *U. kirkiana* show that this parameter is generally low in the nursery after five months. Similar results were obtained by Boyombe *et al.* (2021) on *U. guineensis* in the Yangambi region. In *S. birrea*, the height result obtained under the conditions of our study is higher than that found by Hamidou *et al*. (2014). This difference in growth can be explained by the more favourable pedoclimatic conditions in the humid Miombo of Katanga region than in the Sahelian region of Niger. The influence of environmental conditions on plant growth was also reported by several studies, with plants in humid regions growing better than those in dry regions (Mujike *et al.,* 2023; Msukwa *et al.,* 2016; Abasse *et al.,* 2010; Mwase *et al.,* 2010).

CONCLUSION AND APPLICATION OF RESULTS

The aim of the present study was to lay the foundations for a domestication program for three multipurpose species in the Miombo region of Katanga by assessing their susceptibility to generative propagation by testing different dormancy-breaking techniques. The results obtained show that, these species can be successfully multiplied generatively. The use of freshly harvested seeds, without any treatment, gives the best performance in *S. cocculoïdes* and *U. kirkiana*. With *S. birrea*, on the other hand, soaking seeds in boiling water until they cool is the best seed treatment technique. A growing medium rich in organic matter ensures good plant development in the nursery. It takes about five to six months of nursery training to obtain vigorous plants, capable of developing normally under field conditions. Experimentation with vegetative propagation by testing stem or root cuttings, grafting and layering should be considered. Field observations will enable us to assess their ability to grow and develop under ex situ conditions.

ACKNOWLEDGEMENTS

Our sincere thanks go to the authorities of the Académie de Recherche et d'Enseignement Supérieur (ARES) and the Agence Universitaire de la Francophonie (AUF) for funding this study, which is being carried out as part of the Medicinal Plant Garden Project (JarMed) on the main campus of the University of Lubumbashi. This research was made possible by funding from the Belgium Kingdom through ARES and AUF as part of the JarMed project.

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