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Germination And Growth Test In The Nursery Of Two Spontaneous Plants From Niger: Khaya Senegalensis (Des.) A. Juss. And Securidaca Longipedunculata Fress.

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Abstract
The domestication of spontaneous species involves the production of plants in a nursery before their introduction to the various cultivation sites. For this, it is necessary to have data on the germination and growth of these medicinal species to produce, sow, protect, and fight against desertification. For this, the objective of this study aims to better understand the germinative power of the seeds of two spontaneous species (Khaya senegalensis and Securidaca longipedunculata) and the development characteristics of their seedlings in the nursery. The results show germination rates which vary depending on the species. Thus, for the seeds of Securidaka longepeduculata we note 42.11 and 40% (new and old seeds) germination rate, as for Khaya senegalensis it is a rate of 72%. The growth in height of the seedlings in the first month is greater than that of the root tap for both species. However, we note a length of the pivot greater than the height of the stem from the second month. The analysis of the parameters monitored (height, root length, diameter at the collar, number of leaves) shows that Securidaka longepeduculata recorded the best results. For the seed germination rate, the analysis of variance showed no significant difference (p> 0.05) and it's the same for the other parameters (root length, number of leaves, and diameter at the collar). However, a significant difference was observed between species for plant height. The results of this study showed good potential for sexual reproduction with the germination capacity of the seeds. The introduction of these species into the various reforestation programs or enrichment of protected areas can be a reality and could offer a solution to the pressure exerted on these species for sustainable management, but also fight against the advance of the desert.

Keywords*: Spontaneous species, Nursery, Germination, Growth, Niger.*

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I. Introduction

Tropical forests constitute an immense reservoir of biological resources; they play a fundamental role in meeting many of the needs of populations. (Ahoton, 2009). However, these spontaneous plants are under increasing pressure, due to populations' needs for non-wood and wood forest products (food, pharmacopeia, firewood, timber, and service wood), bushfires, overgrazing, and changes in climate leading to their destruction or even disappearance. Sahelian ecosystems are undergoing significant degradation due to climatic deterioration and strong anthropization. This situation is detrimental to the economy of the countries concerned, and thus to the living conditions of the populations (Diouf *et al*., 2002).The degradation of plant cover, mainly attributed to stressful environmental conditions, land clearing, and overgrazing, results in increasingly harmful effects on the economic and ecological levels (desertification). To better combat this phenomenon, we must seek solutions to improve plant cover and resolve the problems of regeneration of certain forest species in arid zones (Kennenni *et al*., 1990). Man's control of seed germination, over thousands of years of plant domestication, has been decisive in ensuring the proper establishment of crops and better plant production (Salifou, 2000).

The degradation of plant cover, mainly attributed to stressful environmental conditions, land clearing, and overgrazing, results in increasingly harmful effects on the economic and ecological levels (desertification). To better combat this phenomenon, we must seek solutions to improve plant cover and resolve the problems of regeneration of certain forest species in arid zones (Kennenni *et al*., 1990). Man's control of seed germination, over thousands of years of plant domestication, has been decisive in ensuring the proper establishment of crops and better plant production (Salifou, 2000).

However, knowledge of better conditions for seed germination and/or multiplication by cuttings of these species will allow their domestication and will contribute on the one hand to their conservation as well as their valorization and on the other hand to the conservation of biodiversity and the fight against desertification of the environments to which they are dependent (Bellefontaine and Monteuuis, 2000). To this, it should be added that natural regeneration is limited for Securidaca longipedunculata because this plant has a low germination rate and poor seedling growth (Mbuya *et al*., 1994).

According to Guigma *et al* (2012), with population growth and the increase in demand for plant products, certain species are in decline in specific localities. To remedy this, domestication studies of these indigenous species for their use in various reforestation, enrichment programs, and/or in agroforestry systems must be carried out. And this necessarily requires better knowledge of these plants through their methods of propagation. It is within this framework that this study takes place, which aims to better understand the germinative power of the seeds of two spontaneous species (*Khaya senegalensis* and *Securidaca longipedunculata*) and the development characteristics of their seedlings in the plants nursery.

II. Materials and Method

Study area

The germination and growth test in the nursery was carried out at the nursery of the Faculty of Sciences and Technology of the Abdou Moumouni University of Niamey (13°29'58.7" North and 002°05'25.0 " East). The University is located in commune 5 of Niamey on the banks of the Niger River (figure 1). During the experiment, the maximum average temperature was 42.6°C and the minimum average temperature was 16.7°C. The annual rainfall during the experiment is 555.6 mm.

Figure: Location of the study area

Biological material

The plant material consists of seeds of *Securidaca longipedunculata* and *Khaya senegalensis*.

Khaya senegalensis.

It is a large tree, 25-35 m high, with a generally short and stocky bole and 2 m in diameter, sometimes with a small base at the base, with a rounded and dense crown, with the leaves arranged at the end of the branches.

The bark is gray and smooth, becoming more or less ferruginous and scaly, with a more or less carmine pink edge, exuding a little liquid (Arbonier 2000).

The leaves are alternate, paripinnate (sometimes imparipinnate), glabrous, with 3-4 (-6) pairs of opposite or subopposite leaflets, oblong to oblong elliptical, 5-12 x 3-5 cm, with a rounded apex, obtuse or more or less acuminate, with a wedge-shaped or attenuated base, grayish below. The petiole has a length of 12-25cm and the petiole is 3-4 mm long. This plant has pinnate venation, not very prominent, with 8-10 (-16) pairs of secondary veins.

The inflorescence is a fascicle of panicles in the axils of young leaves, 15-20 cm long. The white flower, pedicellate (2-4 mm), 7-8 mm in diameter, with 4 (-5) spreading petals bearing in the center, the red stamens united in a tube. The fruit is erect upwards, globose, woody, 5-10 cm in diameter, light gray when ripe, opening into 4 valves starting at the top and containing flat seeds. As for the seeds, they are flat, rectangular, winged, and more or less blistered. Flowering tends to take place in the first part of the dry season. The habitat of the species is the Sudanian to Guinean savannahs. Prefers deep, well-drained soils, but also adapts to superficial and lateritic soils. It is distributed from Senegal to Cameroon to Sudan.

Securidaca longipedunculata

According to Arbonier (2000), it is an erect shrub or small tree, 3-5 (-10) m high, with an open crown with slender drooping branches. Easily recognizable when in flower, with pink to purple flowers. Its bark is smooth, light yellow to beige, with a green edge and very thin on the surface and yellowish becoming more or less brown below. The branch is gray, finely pubescent, becoming glabrous. The leaves are alternate, arranged in a spiral, and sometimes very closely spaced between them, linear-oblong or elliptical oblong, 2-9 x 1-3 cm, with a rounded top, wedge-shaped base, finely pubescent on both sides, becoming glabrous. The petiole is slightly pubescent, 4-8 mm long. The venation is pinnate, with 5-8 pairs of barely visible secondary veins. Its inflorescence is a terminal raceme of 5-20 flowers, 5-8 cm long. The flower is pink or purple, asymmetrical, with 5 sepals including 2 winged ones appearing to be petals, with 3 petals (1 large and 2 lateral, smaller). The fragrant flower is distinguished from Fabaceae flowers by the 8 stamens, which are clearly visible. The fruit is one-winged, 4-5 cm long. The wing, papery, with a rounded top, a wedge-shaped base, 1.2-2 cm wide, finely veined transversely, is first reddish and then becomes yellowish when ripe. The seed is irregularly wrinkled, more or less flat, sometimes bearing the beginnings of a second wing on its dorsal part. Flowering usually occurs in the second part of the dry season. Often simultaneously in flower and fruit.

This plant is found in the Sudanian to Guinean savannahs, on laterite and rocks in humid areas, and on the banks of rivers in much drier areas.

Securidaca longipedunculata is a Pan-African species that is widespread from Senegal to Cameroon.

Data collection methods

Seed collection and conservation

Securidaca longipedunculata seeds were harvested at maturity from healthy trees in the El Gueza terroir, south of the Maradi region, between longitudes 7°24' and 8°9' East and latitudes 13°13' and 13°45' North.

The seeds of *Khaya senegalensis* were harvested at maturity for a month from healthy trees in Tamou area (Tillabery region).

After harvest, all seeds are put in plastic bags and stored in the laboratory until use.

Substrate preparation

Sowing was carried out in empty 50 kg bags (1 m high and 0.6 m in diameter). Each bag was filled with manure mixed with sand in proportions of 1/4 and ¾ respectively. All bags are sown at the rate of 5 seeds without treatment and exposed to direct sunlight. Every month ten seedlings are collected and measured in the laboratory. The monthly observations and measurements carried out focused on the diameter of the collar, the height, the length of the roots, and the number of leaves.

Watering began even before the installation of the device and was done twice a day (morning and evening), so the daily quantity of water used is 36 liters. Weeding was permanent and the young plants were safe from predators.

Germination test

The factors controlled in the study were the diameter of the collar, the number of leaves, the height, and the length of the roots.

According to Abdourhamane *et al*., (2014), germination aims to define the different stages of development and to characterize the speed of morphological modification of the seedling to adapt to environmental conditions.

Germination tests were carried out at room temperature. A seed is considered germinated when both cotyledons emerge. The seeds are sown in polyethylene pots and also in 50 kg bags filled with substrates. All pots are sown at 2 seeds per pot; as for the bags, they are sown at the rate of 5 seeds per bag.

The seeds were sown without pretreatment.

For *Securidaca longipedunculata*, two types of seeds were used for the germination test, namely seeds with seed coats and others without seed coats. These seeds are of two different ages: New and old (one-year-old).

The one-year-old seeds were collected and then stored in plastic bags in the laboratory under the best conditions until use.
For *Khaya senegalensis*, the seeds used are those harvested and sown in the same year.

Data processing and analysis
Parameters observed

For this study, the germination criterion and parameters defined by Evenari (1957) and Come (1968) used by several authors (Côme *et al*., 1982, Abdourhamane *et al*. 2014) are retained; it's about:
• the germination rate (Tg), calculated according to the formula:

$$Tg = 100 * \frac{Nombre\ de\ graines\ germés}{Nombre\ \ de\ graines\ semées}$$

• time or duration of germination in days: duration between the first and last germination, which corresponds to the duration of the experiment ;
• latency time or germination time in days which is the duration between sowing and first germination;
• the average seed germination time;
• the height of the plants;
• the length of the roots.

Statistical analyses were carried out using Excel and Mini Tab software. The difference between growth parameters was assessed by one-way analysis of variance (ANOVA). The Student t-test at the 5% threshold was used for comparisons.

III. Results

Characteristics of germination
Securidaca longipedunculata

The germination time is 22 days, i.e. from the 8th to the 31st day after sowing. From the 31st day to the 45th day of germination monitoring, no seeds of *Securidaca longipedunculata* were able to germinate. For the old *Securidaca longipedunculata* seeds, germination lasted 19 days (from the 9th to the 28th day).

Figure 32 shows the germination rate of the two types of seeds. These two curves show the same trends whatever the duration of the seeds, the differences appeared from the 9th day. The germination rate of new seeds on the 8th day is 4.21%, rising to 42.11% on the 31st day. The old seeds have a germination percentage of 3.16% on the 9th day reaching 40% on the 28th day.

The germination rate gradually increases over time (Figure 2). For newly harvested seeds and those stored for a year, they increase significantly. However, with seeds stored for a year, the germination rate is slightly lower than that of newly harvested seeds. Note that no seeds of *Securidaca longipedunculata* (Newly harvested and those kept for one year) without hull germinated during this experiment.

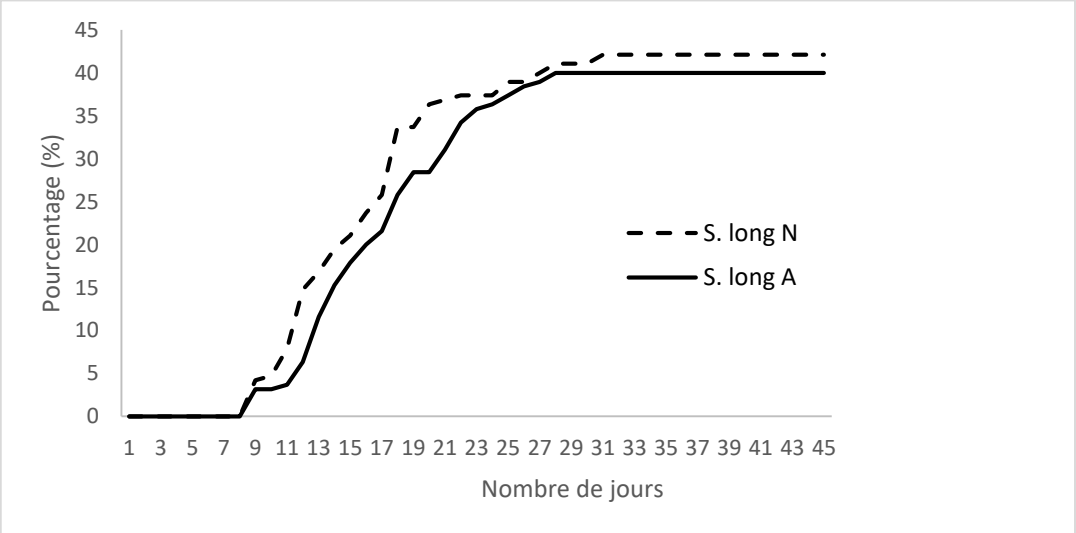

Figure 2: Evolution of the germination rate of *Securidaca longipedunculata*

Khaya senegalensis.

Figure 3 gives the number of days between the sowing and first germination of *Khaya sengalensis* seeds. Thus, 8 days after sowing, the first seedlings appeared. The seeds continued to germinate until the 32nd day. Thus the germination rate increases from 2.22% to 72.22% from the 8th day to the 32nd day respectively.

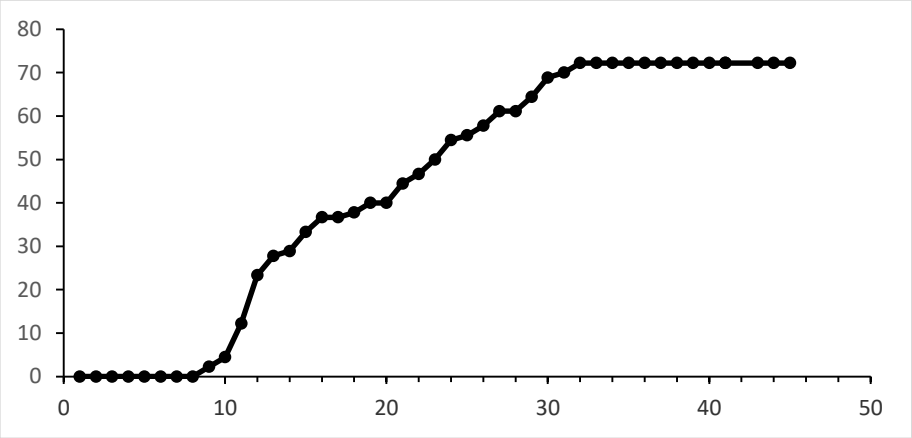

Figure 3 : Evolution of the germination rate of *Khaya senegalensis*

Growth of seedlings in the nursery

Securidaca longipedunculata

Two months after sowing, the average growth in height of the aerial part remains greater than the underground growth of the root tap for the new and old seeds respectively (Figure 4). In the third month, we notice a change in the average growth of the root tap that is greater than that of the aerial part for both types of seeds.

The average height of the aerial part is 10.33 and 11.93 for the old and new seeds respectively, reaching 23.02 and 24.01 cm four months later. Which gives an elongation of 7.32 and 7.42 respectively for the old and new seeds. However, a slight growth of the stem is observed during the third and fourth months with an average monthly elongation of 5.22 and 0.12 for the new seeds and for the old seeds (4.45 and 0.3). The growth of the root tap is 8.25 and 8.52 to reach four months later 32.01 and 30.97 cm for the old and new seeds respectively. Which gives an elongation of 3.65 and 6.5 in the second month for the old and new seeds.

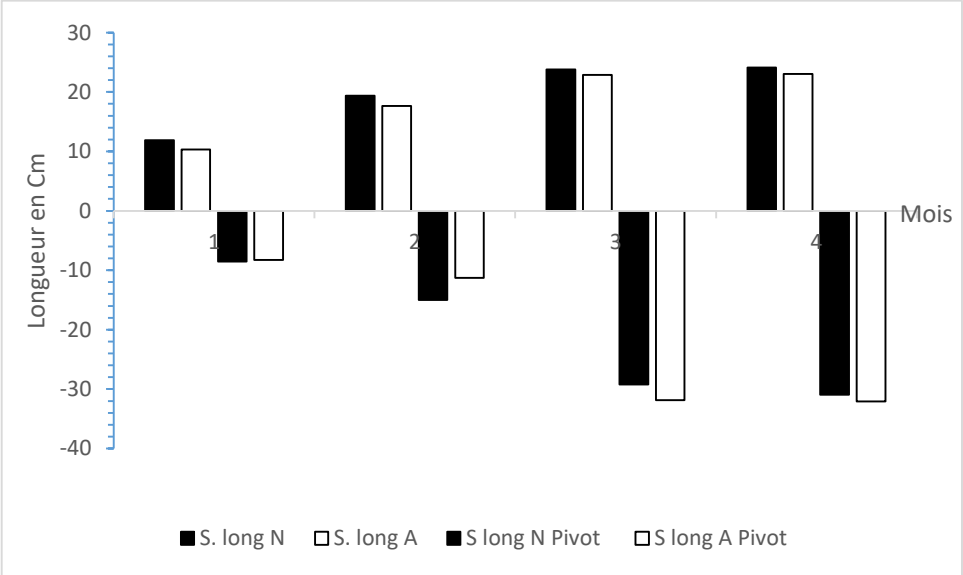

Figure 4: Evolution of stem and root growth of *Securidaca longipedunculata*

The average crown diameter of plants from new seeds is greater than that of plants from old seeds (Figure 5). In the fourth month, the diameter at the collar of the new seeds is 3.03 cm and that of the old seeds 2.2 cm. The average stem diameter varied between 1.1 and 3.3 cm for new seeds and between 1 and 2.2 cm for old seeds.

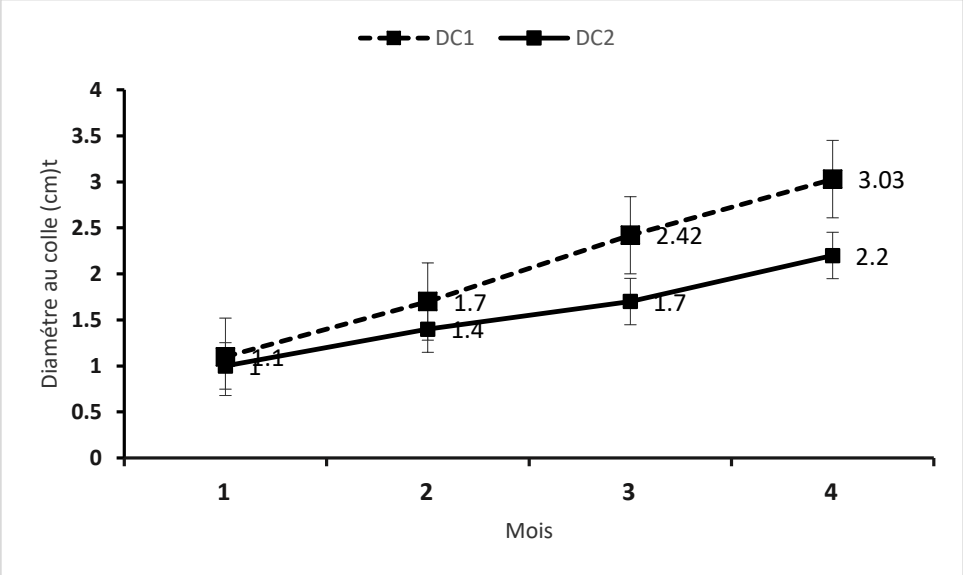

Figure 5: Evolution of the diameter at the collar of *Securidaca longipedunculata* seedlings

One month after sowing the number of leaves is equal to 8.5 and 7.54 for the new and old seeds respectively. From the first month to the fourth month, we see an evolution in the number of leaves per seedling and for all types of seeds. The leaf number for *Securidaca longipedunculata* in the fourth month is 13.8 and 13.1 for new and old seeds respectively (Figure 6).

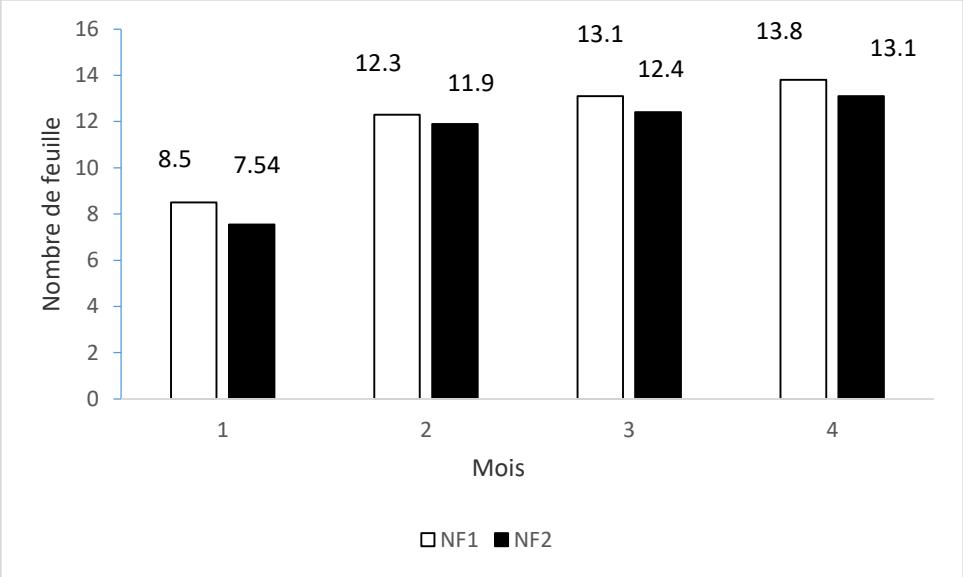

Figure 6: Evolution of the number of leaves of seedlings *Securidaca longipedunculata*

Khaya sengalensis

One month after sowing the seeds of *Khaya senegalensis*, the average growth in height of the aerial part 8.47 cm, is greater than the underground growth of the root tap which is 7.67 cm. In the second month, the growth of the stem is 10.18 cm (Figure 7), which gives an elongation of 2.09. This aerial growth is slightly less than that of the underground part (10.18 cm).

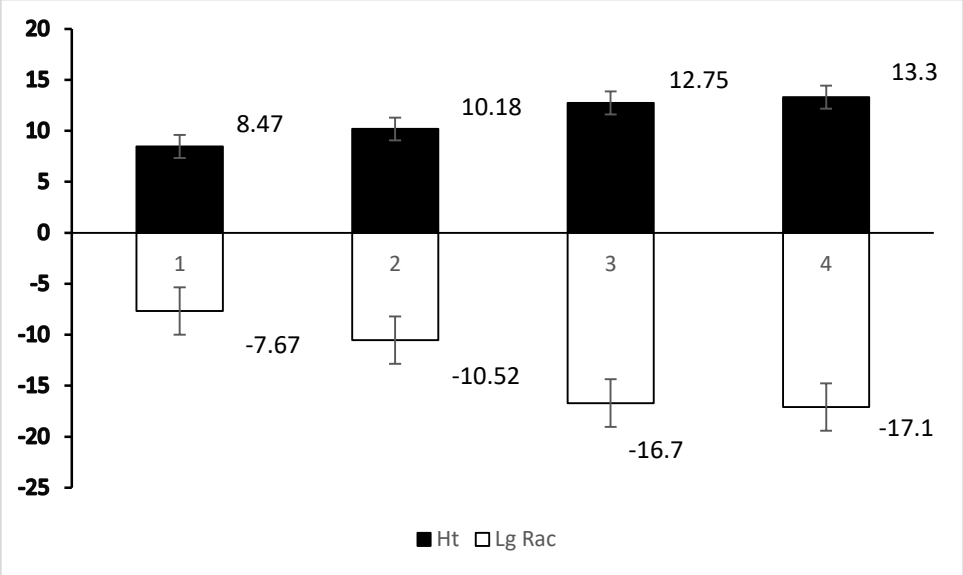

Figure 7: Evolution of stem and root growth of *Khaya senegalensis*

The collar diameter of *Khaya senegalensis* is 1 cm in the first month, it reaches a value of 2.28 cm in the fourth month (Figure 8).

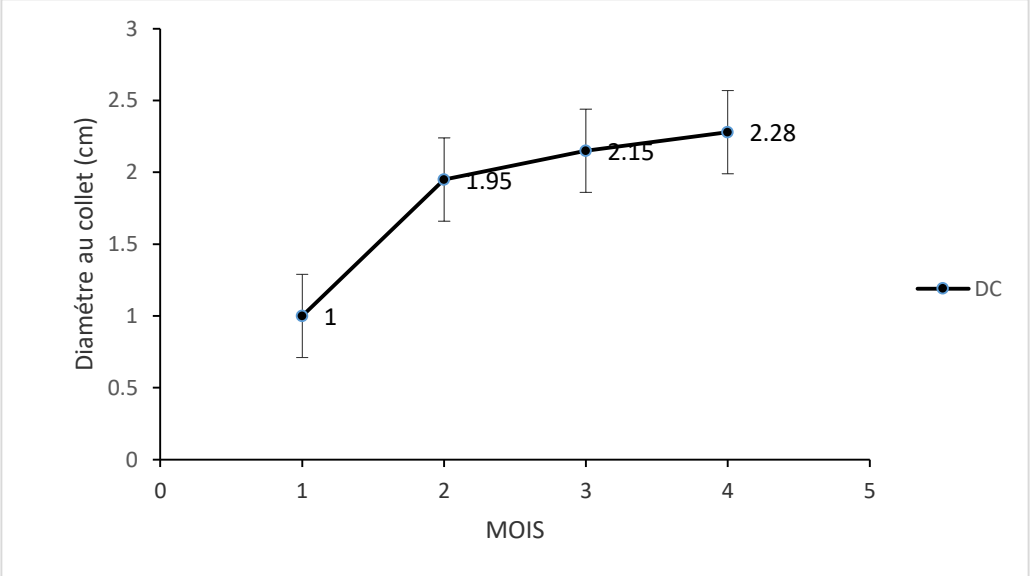

Figure 8: Evolution of the diameter at the collar of Khaya senegalensis seedlings

One month after sowing the number of leaves is 4.2 for *Khaya sengalensis*. From the first month to the fourth month, we see an evolution in the number of leaves per seedling. This number of leaves reaches 7.8 in the fourth month (Figure 9).

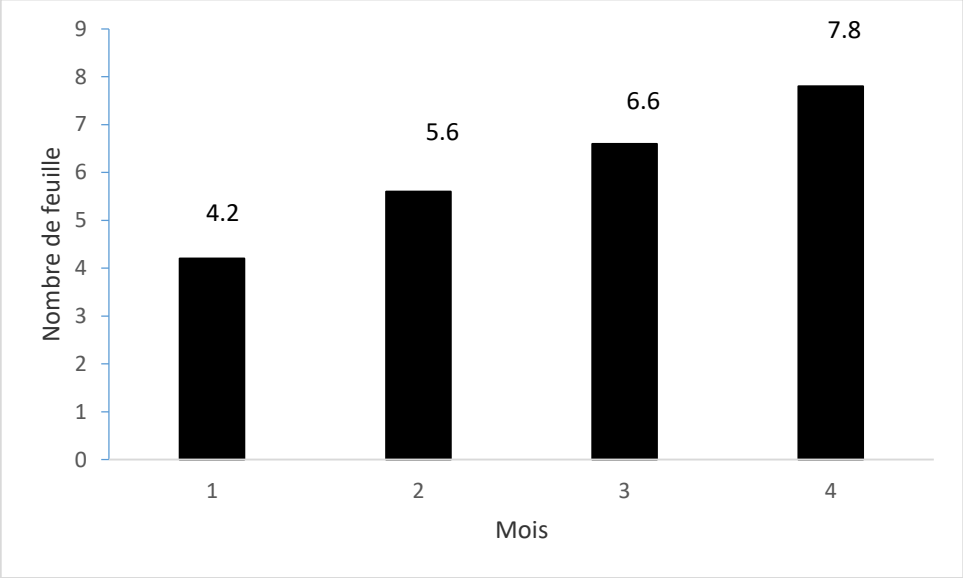

Figure 9: Evolution of the number of leaves of *Khaya senegalensis* seedlings

Comparison of the average values of the parameters monitored shows that there is no significant difference between the diameters at the collars, the lengths of the roots, and the number of leaves of *Securidaca longipedunculata* (New and old seeds) and *Khaya senegalensis* (Table 1). However seedling height showed a significant difference with analysis of variance. The student test showed a non-significant difference between the seedlings of *Securidaca longipedunculata*, however, there was a significant difference between them and those of *Khaya senegalensis*.

It should be noted that there is a significant difference between the root of *Securidaca longipedunculata* and that of *Khaya senegalensis* (Table 1).

Tableau 1: P value during the analysis of measured parameters

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Source	P value			
	Ht	Lra	Nbre Feu	DC
Species	0,04	0,31	0,13	0,8
Sn*Sa	0,89	0,74	0,84	0,39
Sn*Ks	0,009**	0,02*	0,06	0,88
Sa*Ks	0,01*	0,09	0,07	0,14

P : probability; Sn: *Securidaca longipedunculata* new seeds; Sa : *Securidaca longipedunculata* seeds of one year ;Ks : *Khaya senegalensis* ; Ht : Seedling height; Lra : Roots length ; Nbre Feu : Nomber of plant leaves; DC : Collar diameter ; *** very highly significant; **highly significant; *significant ; ns : not significant.

IV. Discussion

From the analysis of the data, it appears that the new and old seeds have the same waiting time, namely 9 days. This result is lower than that of Donald *et al*., (2011) who recorded a delay of 15 days after sowing.

With a germination rate of 40 to 42.11% for the old and new seeds respectively for *Securidaca longipedunculata*, the latter germinated less than those of *Khaya senegalensis* which recorded a rate of 72%. However, the newly collected *Securidaca longipedunculata* seeds recorded a slightly higher germination rate than those dating back a year. This difference could be linked to the storage time of the seeds.

This study of the germination of *Securidaca longipedunculata* revealed potential for average seed germination without treatment. With 42.11 and 40% (new and old seeds), these results obtained for germination are similar to those of Donald *et al*., (2011) who recorded germination rates of less than 43% for their ex vitro study under greenhouse with the same species. However, these authors' in vitro results with 67 to 90% germination rates are higher than those of the study. It should also be noted that the results of the study are also comparable to those of Ouedraogo *et al*, (2003) in Burkina Faso with less than a 45% germination rate for the same species.

Monitoring the number of leaves per seedling did not show any significant difference between *Securidaca longipedunculata* seed types. But the number of leaves of the new seeds is slightly higher than that of the old ones. After 4 months of monitoring in the nursery, the *Securidaca longipedunculata* species had the highest

number of leaves. However, there is not a significant difference between the number of leaves of *Securidaca longipedunculata* and *Khaya senegalensis*.

Securidaca longipedunculata and *Khaya senegalensis* are species with slow initial growth. This growth is significantly lower, after two months it is only 10.18 and 12 for *Securidaca longipedunculata* (old and new seeds respectively) and 13.3 cm for *Khaya senegalensis*. This low growth was observed in several spontaneous species: Amani et al., (2015), recorded during their study respectively for *Combretum glutinosum*, *Combretum micranthum*, *Combretum nigricans*, and *Guierra senegalensis* a height of 7.71 ± 2.97; 17 ± 6.05; 18.06 ± 5.84 and 25.8 ± 0.81 cm during 100 days of follow-up. After five months, the growth of *Prosopis africana* varying from 13.38 to 20 cm for the stem was observed in Benin (Ahoton *et al*., 2009). Yelemou *et al*., (2009) recorded 18 and 10 cm in height on Saria soil and sand respectively for *Piliostigma reticulatum* in Burkina Fasso for 70 days.

The average length of the root system is 11.9 cm and 15.02 in the second month reaching 30.97 and 32.2 cm in the fourth month for old and new seeds of *Securidaca longipedunculata* respectively. According to Bationo *et al*. (2005), the ability of seedlings to quickly develop a tap root system allows them to alleviate constraints linked to competition, particularly herbaceous competition, and edaphic drought. This shows the important role that the roots play in the plant's attachment to the soil, but also in the search for water and mineral salts, the main factors behind the germination and development of the plant. This root development can explain the presence of this species in its expansion zone where it must cope with a lack of water. The roots of new seeds are longer than those of old seeds.

There was no significant difference between the two types of seeds (New and old) of *securidaka longipedunculata* during this study for all the parameters analyzed.

V. Conclusion

The domestication of spontaneous species involves the production of plants in a nursery before their introduction to the various cultivation sites. For this, it is necessary to have data on the germination and growth of these medicinal species in order to produce, sow, protect, and fight against desertification. This led to this study on the germination of two spontaneous species (*Khaya senegalensis* and *Securidaca longipedunculata*), thus demonstrating that these species can be domesticated and used in various reforestation and/or enrichment programs for wooded areas.

This study showed a moderate germination potential (40 and 42.11%) with an average height of the aerial part which is 23.02 and 24.01 cm for the old and new seeds respectively for *Securidaca longipedunculata*. For Khaya senegalensis we note good germination with 72.22% for an average height of 13.3 cm. The presence of these two species in various bioclimatic regions of Niger is made possible thanks to their highly developed root system allowing them to seek water in deep water tables. Given the different pressures exerted on spontaneous species and also their importance for the local population, the results of this study could be used to constitute a database of spontaneous plant species used in the various programs to combat desertification.

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