Effects of different soil substrates on the germination emergence and growth of cashew varieties (*Anacardium occidentale* L.) at the ISRA station in Sangalkam/Senegal

Abstract

The cashew tree (*Anacardium occidentale* L.) contributes to the socio-economic development of several African countries, including Senegal. Production continues to face several constraints related to a drop in yield, ageing of plantations, high density and the use of non-performing plant material. Several researches are being carried out across West Africa to significantly improve cashew production and productivity. However, in recent decades, the meteoric rise of cashew plantations in West Africa should pose the problem of land availability and land that would be more suitable for cashew cultivation in the near future. It is in this context that Shelter For Life imported a variety from Vietnam in order to test its germination emergence, its adaptability on 5 soil substrates: sandy (T1), clay (T2), sandy-clay (T3), clay-sandy (T4) and dune sand (T0), in order to improve productivity in the SeGaBi zone. On these different substrates, the local (V1) and Vietnamese (V2) varieties were sown, following a split plot system. The results showed that the germination rate varies with variety and time ($P<0.05$). V2 obtained a germination rate of 56.67% against 36.67% for V1 while the emergence time is 26 days for V1 against 33 days for V2. The germination rate also varies according to soil texture: T0 (83.33%), T3 (75%), T1 (46.33%), T4 (25%) and T2 (8.33%). Growth parameters varied with time ($P < 0.0001$). The highest height was obtained on T0 (31.7cm) and the lowest on T3 (26.2cm) at 90 days after sowing (90JAS). The diameter and number of leaves varied according to the variety ($P < 0.01$). V2 obtained an average of 12 leaves compared to 8 leaves/plant for V1 at 75JAS. The highest neck diameters were obtained in V2 (0.69 cm) compared to 0.52 cm in V1. The Vietnamese variety adapts well to the sandy-clay substrate. The Vietnamese variety on sandy-clay substrate could help boost national cashew nut production. The results obtained reflect only a first trend. Thus, it would be useful to continue the study to have more information on the behavior of the two varieties.

Keywords: *Anacardium occidentale* L, Substrates, Varieties, Germination, Growth parameters

1. INTRODUCTION

The cashew tree (*Anacardium occidentale* L.) is a plant of the savannah areas, native to Brazil (Oluyole *et al*. 2017). It is produced mainly for its fruit and cashew nuts remain highly prized in international trade. Through the income it brings to producers, cashew nuts participate in the socio-economic development of many rural households around the world (Assih and Nenonene, 2022). It is a plant with multiple uses (pharmacopoeia, fuelwood and servicewood, food, oil, soap, chocolate, etc.) with considerable potential, especially in agroforestry systems (Niang, 2002; Djaha, 2010). Global production of raw cashew nuts is estimated at 3,396,680 t for a cultivated area of 3,276,756 ha in 2019 (Semporé *et al*. 2021). Nut production in Africa is estimated at 2,334,405 t. Africa is the world's largest producer and exporter of cashew nuts, accounting for more than 50% of production (Semporé *et al.* 2021). In Senegal, the main production areas are the regions of Sédhiou, Kolda, Ziguinchor and Fatick (Nugawela *et al*. 2006). Today, cashew harvesting is one of the most profitable activities with a yield of 542 kg.ha-1 (Samb, 2019). This evolutionary dynamic of cashew plantations was observed by Samb et al. (2018). The dependent population represents about 14.80% of the total population of these regions and contributes to feeding 20% of the population of these

four regions (Fatick, Kolda, Sédhiou and Ziguinchor) (IRD/CEP 2, 2017). However, yields per hectare are estimated at 542 kg. ha-1 in Senegal are low compared to those of Guinea Bissau (1,200 kg.ha-1) (Samb, 2019). Better still, out of a global production of 2,200,000 t, Senegal represents only 0.8% (Planetoscope, 2019). This situation can be explained by the lack of use of selected and improved varieties and the ageing of plantations. Indeed, germination is one of the most sensitive stages in the life of a plant (Koochaki, 1991; Ly *et al*. 2015). Cashew producers face enormous difficulties due to several factors such as insufficient technical supervision, the use of low-productivity varieties and unknown origins (Sarr, 2002; Ndiaye *et al*. 2017). This situation of low productivity requires the involvement of research and development structures in order to provide the required solutions. It is in this context that Shelter For Life's LIFFT-Cashew project in conjunction with the Senegalese Institute of Agricultural Research (ISRA) imported cashew seeds from Vietnam in order to improve quality and productivity in the SéGaBi zone. This research work aims to study "The *effects of different soil substrates on the germination emergence and growth of cashew varieties in controlled conditions*".

The objective of this study is to contribute to the improvement of cashew productivity in Senegal.

Operationally, the study explores three specific objectives, namely:

- Evaluate the behavior in a controlled environment of a variety from Vietnam;
- Identify the type of soil best suited to this origin;
- To offer growers the best soil/plant combination for growing this provenance.

This research aims to test hypotheses that:

H1: the Vietnamese variety has a higher germination rate than the local one;

H2: the Vietnamese variety adapts better to the sandy-clay texture;

H3: The growth and development of the plants is better in the Vietnamese variety.

2. MATERIAL AND METHOD

2.1 Description of the study environment

The research activities took place at the ISRA experimental station in Sangalkam (Latitude 14° 46' 44.30" N, Longitude 17° 13' 33.65" W, Altitude 19 m), located in the rural community of Sangalkam, which rural community is located in the Dakar region, Rufisque department (Figure 1).

The climate is sub-Canarian and the soils are clayey, sandy, clayey-sandy, sandy-clayey, rich in organic matter. In the hot and rainy season (June to October), average temperatures range from 25 to 30 °C. In the cool season (November to April), average temperatures vary between 19 and 23 °C. The average annual rainfall varies around 400 mm (Camara *et al*., 2013).

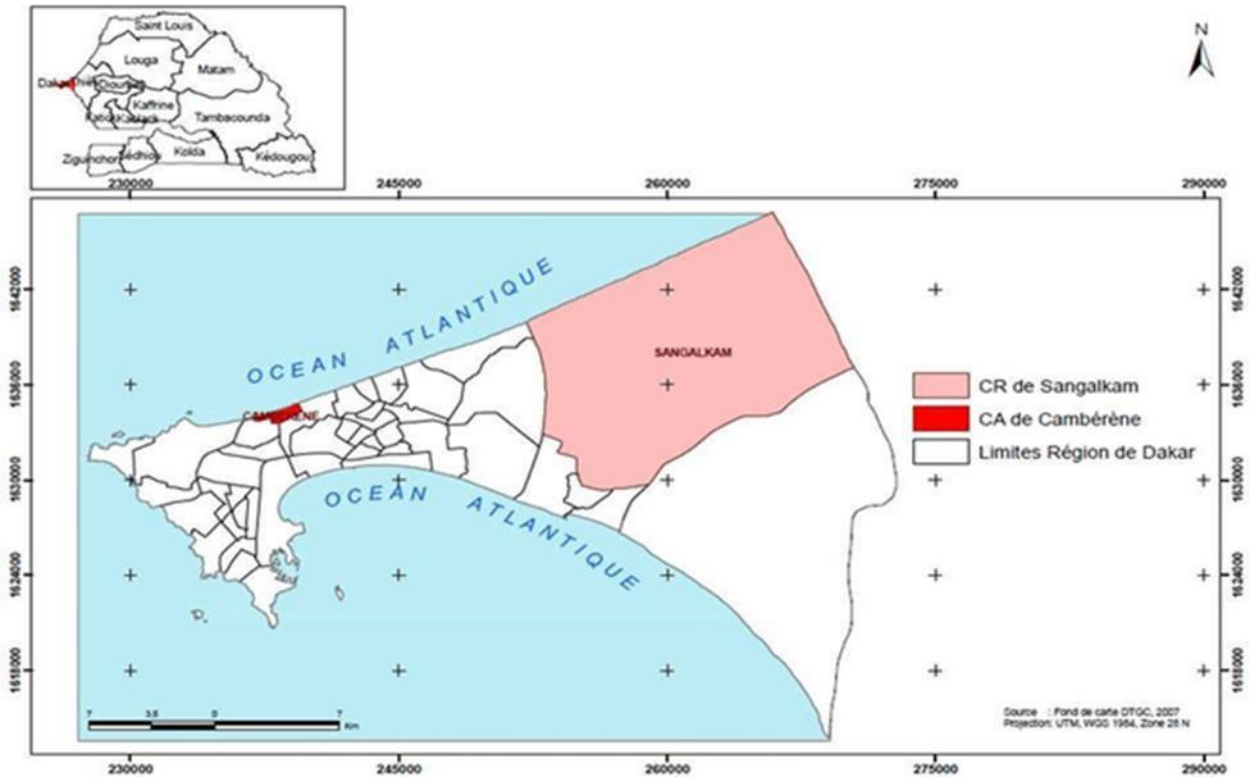

Figure 1: ISRA-CDH research station in Sangalkam in the Dakar region (Camara et al., 2013).

2.2. Plant material

The plant material to be tested is composed of cashew nuts from Vietnam and a local Senegalese variety. The cashew variety (PN1) is a new variety imported from Vietnam (V2) that has great adaptability. The name assigned to this selection is: *SFL/ISRA 30723*. Native to *TrueCoop /Vietnam*, it has fruiting agronomic characteristics varying from 10 to 15 fruits per $^{cluster\text{-}1}$; a number of nuts between 140-160 $^{grains.kg\text{-}1}$. This variety is already available at the level of several multipliers in the SéGaBi region with pilot growers, but also in the research centers of ISRA-NARI (LIFFT, cashew Project). It is characterized by an erect port; a dark green colour of the leaves; flowering in clusters; a grey colour of the nut. This variety gives a potential yield of 2,500-3,000 kg.ha-1 (Le Quy Kha-FR, 2017). The seeds were imported in February 2023. The nuts of the local variety (V1) used in this study give a yield varying from 250 to 400 kg.ha-1 (Ndiaye *et al.* 2017). They were harvested in March 2023 in Keur Martin in the Fatick region of Senegal. **2.3. Experimental design**

The experimental setup is a split plot with 2 factors. The main factor studied is the variety with 2 levels; the local variety (V1) and the Vietnamese variety (V2) and the second factor studied is the soil texture with 5 levels; dune sand (T0), sandy soil (T1), clay soil (T2), sandy-clay soil (T3) and clay-clay soil (T4). This makes a total of 10 treatments. The device is made up of 03 blocks 1 m apart from each other. Each block is 3.5 m long and 0.5 m wide, i.e. an area of 1.75 m2. It is divided into 05 sub-blocks corresponding to the 05 soil substrates on which the two varieties of cashew tree are randomized. Each block contains 20 sheaths and a seed has been sown in each sheath.

The seeds were sown according to the following pattern (Figure 2).

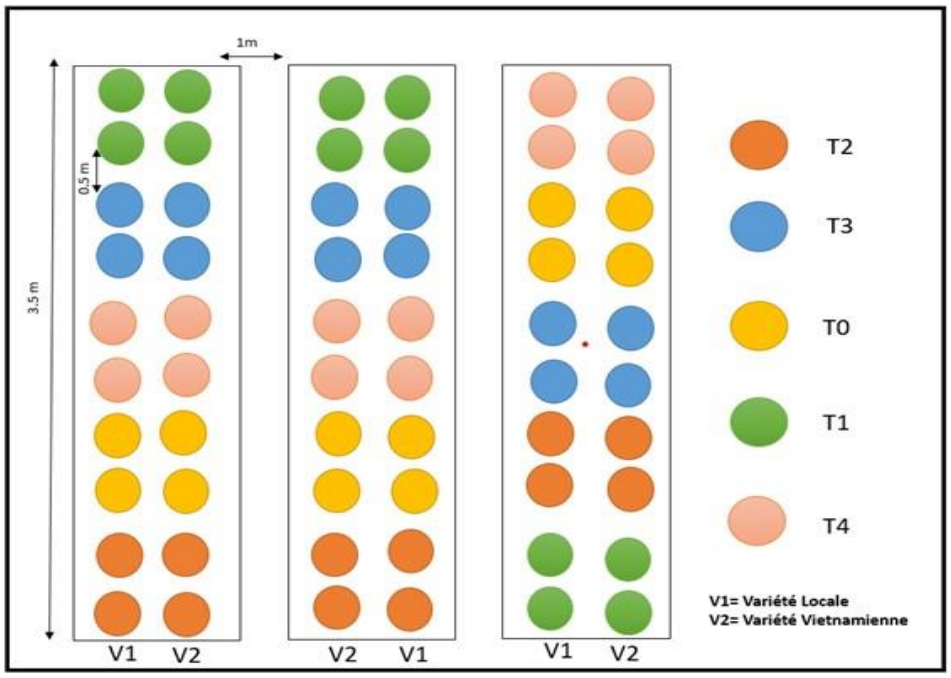

Figure 2: Split-plot experimental setup

T3: the texture is composed of 2/3 sand to 1/3 clay; T4:
the texture is composed of 2/3 clay on 1/3 sand.
The potting substrate was composed as follows: 2/3 of a texture for 1/3 of well-decomposed manure except for control T_0.

2.4. Sowing the nuts and maintaining the nursery

The nuts were sown on September 05, 2023 according to the dorsal position and without pre-treatment in the different types of substrates repotted in sheaths of the same dimensions (width: 14 cm; length: 24 cm). The nuts were buried in the substrates, 3 cm deep. After sowing, the ducts were well watered. Using manual watering cans, the blocks were watered at a rate of 24 liters per block per day during the 30 days after sowing. A shade house has been installed to limit heat stroke.

2.5. Data collected

Daily observations were used to record germination emergence dates and to count the number of germination emergences during the 30 days following the day of planting. Then, observations on germination were made weekly because of the slow germination emergence observed on some substrates. The following parameters were evaluated:

- Germination rate (VG) = time after which 50% of the seeds have germinated (Come, 1970; Scott *et al.* 1984).
- Germination time (DG) = time interval between sowing and the first germinated seeds (Bayarassou, 2011; Samb, 2015).

Thirty (30), forty-five (45), sixty (60), seventy-five (75) and ninety (90) days after sowing, measurements of diameter, height and number of leaves were made in each block. The height of the main stems of the

plants was measured using a ruler (cm). The diameter at the collar of the plants was measured using a caliper. The number of leaves for each plant was also determined by counting.
Other observations such as mortality after germination and the behaviour of plants after emergence were noted.

2.6. Data analysis

The final emergence rate (FFR), Germination rate (VG) and Germination time (GSD) were determined according to the following formulas:

- Final Lift Rate: $TLF = \frac{nombre\ de\ graines\ levées}{nombre\ total\ graines\ semées} \times 100$

To assess the vigour of the seedlings, a comparison of plant height, diameter and number of leaves per individual was made. According to Alexandre (1977), the height/diameter ratio is an index of the respective vigour of the above- and below-ground parts of the plant. According to Devineau (1991), a high height/diameter ratio reflects a predominance of terminal growth over cambial growth and is due to a defect in energy inputs. The higher the ratio, i.e., above 80, the more thread-like and poorly maintained the plants are (Hamawa *et al*. 2019).
The statistical analysis of the data was conducted using R software version 4.2.1. First, a Shapiro Wilk Normality Test (Shapiro *et al*., 1965) was performed before doing the 4-factor ANOVA to identify large sets and locate the level of difference between the treatments if the data are normal and nonparametric Wilcoxon.test and Kruskal-Wallis tests for abnormal data. In addition, the Tukey Test was conducted to perform a multiple comparison of the two-to-two means to identify treatments in which a significant difference was noted.

3. RESULTS

3.1. Seed germination

3.1.1. Cumulative Lift Rate During the 30 JAS

The seeds sown in the experimental setup were observed daily in order to monitor emergence after germination. The first emergence was observed on the 14th day after sowing in V1. On day 15, the first emergence was observed in V2.
During the 30 days after planting, a emergence rate of 36.67% was obtained in V1 and 50% in V2. The germination rate (VG) is therefore faster with the Vietnamese variety than with the local variety. It was on the 26th day after sowing that 50% of the seeds sown of the Vietnamese variety germinated. The Wilcoxon test did not detect any significant differences in germination emergence by variety (p-value = 0.6448). The germination rate increases with the day for both varieties. From the 26th day after sowing (JAS), no emergence was recorded for the rest of the 30 JAS (Figure 3).

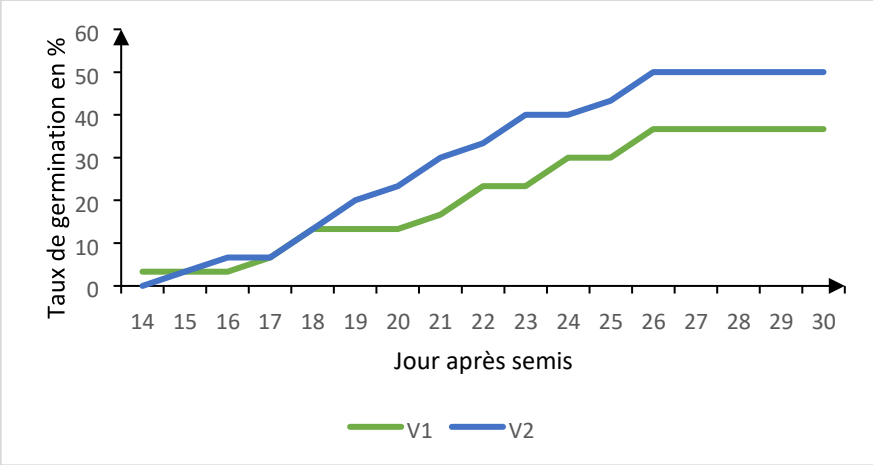

Figure 3: Emergence rate over time depending on the variety

3.1.2. Lift rate

In total, the lift rate recorded is 56.67% for V2 and 36.67% for V1. However, the Wilcoxon test showed no significant difference in the number of rises depending on the varieties for p-value = 0.3238 (Figure 4).

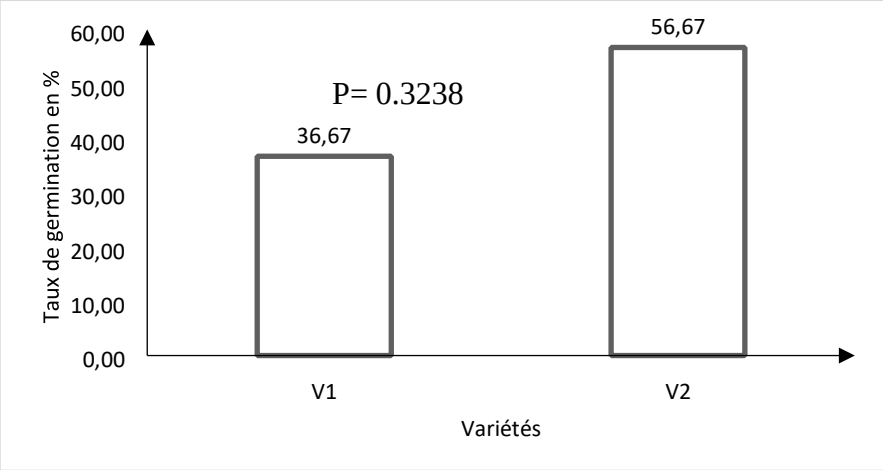

Figure 4: Germination emergence rate depending on the variety

3.1.3.Emergence rate during the 30 days of the day

The substrates on which the first emergences were observed were T1 (14th day after sowing) followed by T0 (15th day after sowing). It was at the 16th JAS that T3 recorded its first fundraising and at the 18th JAS for T4.

No significant difference was observed between the number of lifts and the texture at p-value = 0.07771. However, arithmetically, T0 recorded the highest lift rate (83.33%) followed by T3 (75%), T1 (41.67%), and T4 (16.67%). However, it should be noted that no emergence was observed during the 30 days after planting on T2 (Figure 5).

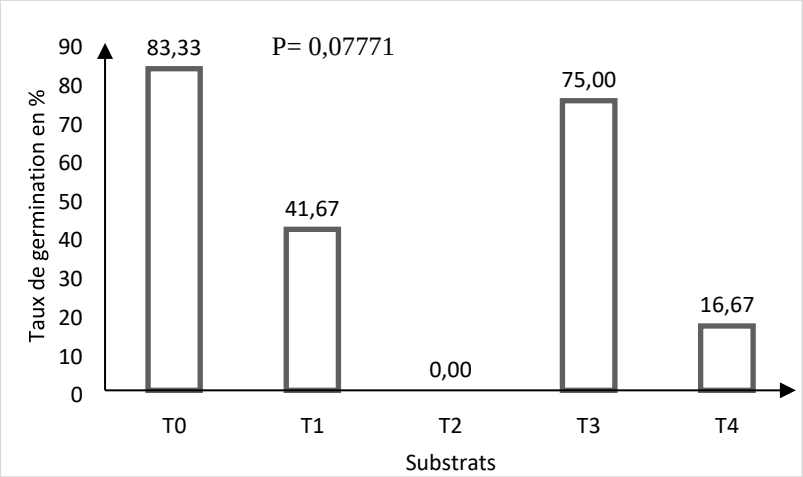

Figure 5: Texture-dependent emergence rate on 30 days

3.1.4. Emergence after 30 days after sowing

The first emergence of the 100% clay texture was recorded on the 33rd day after sowing with the Vietnamese variety. In the same week, two rounds of fundraising were recorded on Q1. In Q4, a lifting was observed the following week.

In the end, the emergence rate as a function of the substrates is represented in Figure 7 with T0 (83.33%), T1 (41.67%), T2 (8.33%), T3 (75%) and T4 (25%).

The emergence rate did not vary significantly depending on the substrate (P=0.2114). However, arithmetically, the highest germination rates were recorded on T0 (83.33%) and T3 (75%). T2 gave the lowest germination rate (8.33%) (Figure 6).

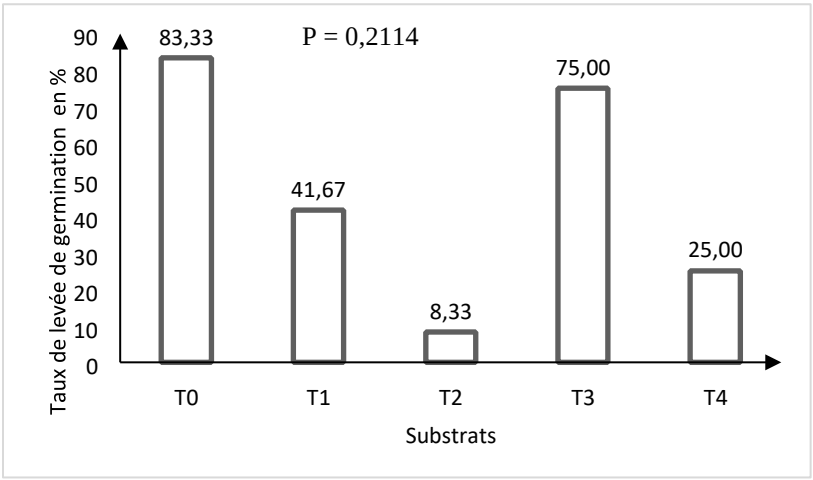

Figure 6: Total Rise Rate Based on Texture

The emergence rate varies significantly with time (P = 0.04677). The highest emergence rate was obtained in the week of 21-27 JAS (53.57%) and the lowest was obtained in the week of 28-34 JAS (7.14%) (Figure 7).

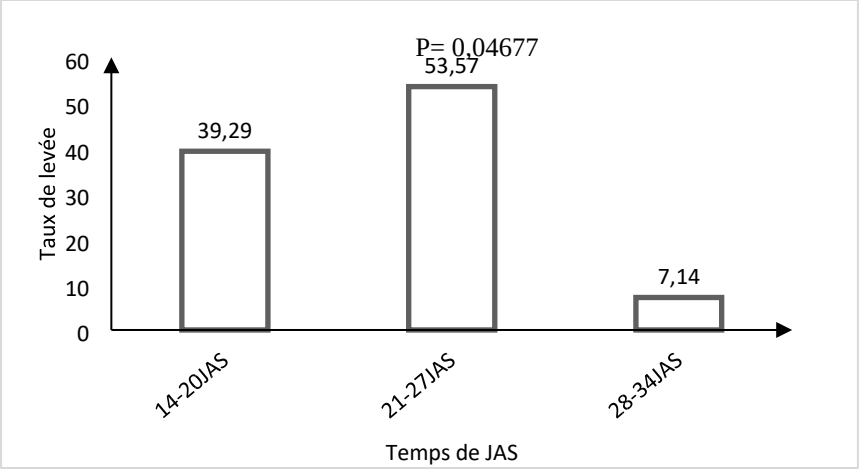

Figure 7. Lift rate as a function of time

3.1.5. Plant mortality and defects as a function of variety and texture.

A growth defect was observed on T0. Growth retardation was observed with the T2 and T4 substrates of the V1 variety. There was also an interruption in germination emergence on T1. At 60 JAS, the mortality rate is relatively low, 14.29% in V1 and 10.71% in V2 (Figure 8b). The highest mortality rates were recorded in substrates T0 (10.71%) and T3 (7.14%) (Figure 8a).

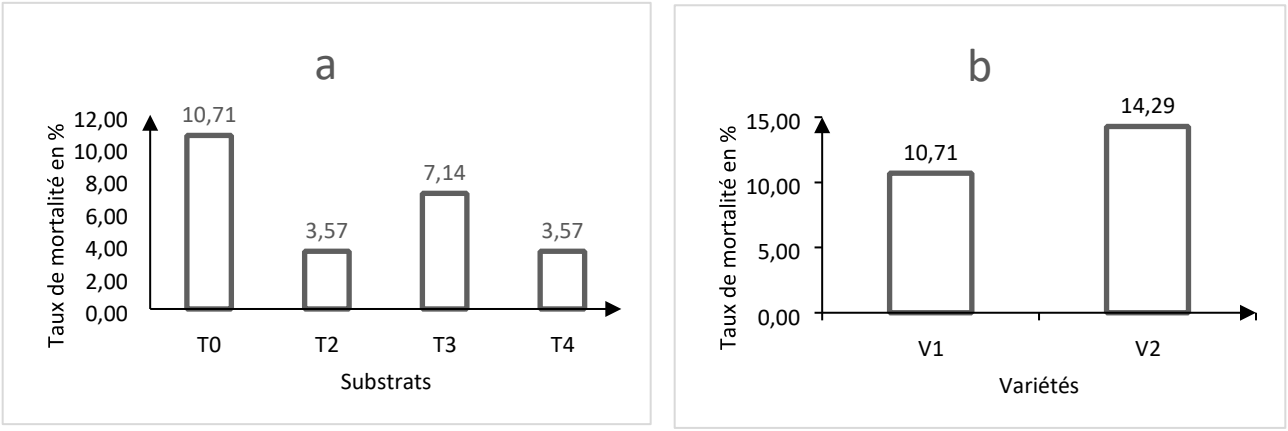

Figure 8: Mortality rates by substrate (a) and variety (b)

3.2. Variation of plant growth parameters by variety and texture

A very highly significant difference (P=0.000728) was noted between the mean heights according to the substrates at 90 JAS. Following the average height, the T0 texture gave the highest (31.57 cm) followed by T1 (29.06 cm) and T4 (28.83 cm), the lowest height was obtained with T3 (24.62 cm) (Figure 9). The diameter varied very significantly depending on the variety (P= 0.00413) and the soil texture (P= 0.00111). The number of leaves showed a very significant difference between the varieties (P = 0.00137).

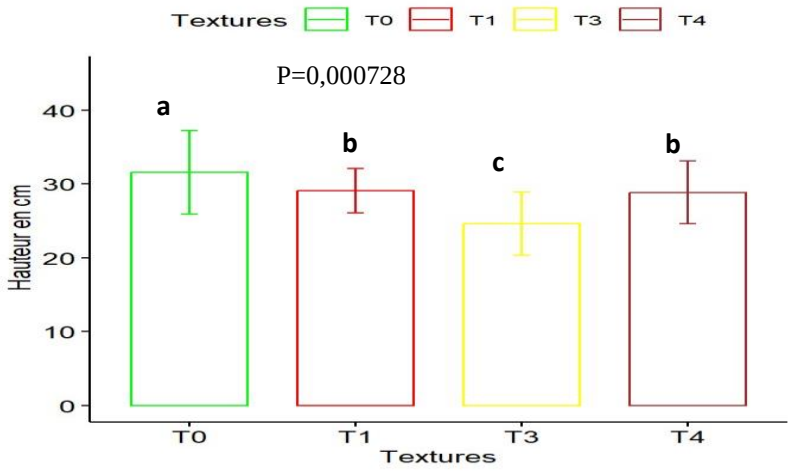

Figure 9: Variation in plant height depending on substrates

The diameter varied very significantly depending on the variety (P = 0.00413). V2 plants have the largest diameters (0.61 cm) compared to V1 plants (0.53 cm) (Figure 10). A very significant difference in diameters was noted according to the textures (P = 0.00111). T1 plants have the largest diameters (0.67 cm on average) followed by T4 (0.60 cm) and T3 (0.58 cm). The lowest diameters were obtained with plants with a T0 texture at 0.49 cm (Figure 11).

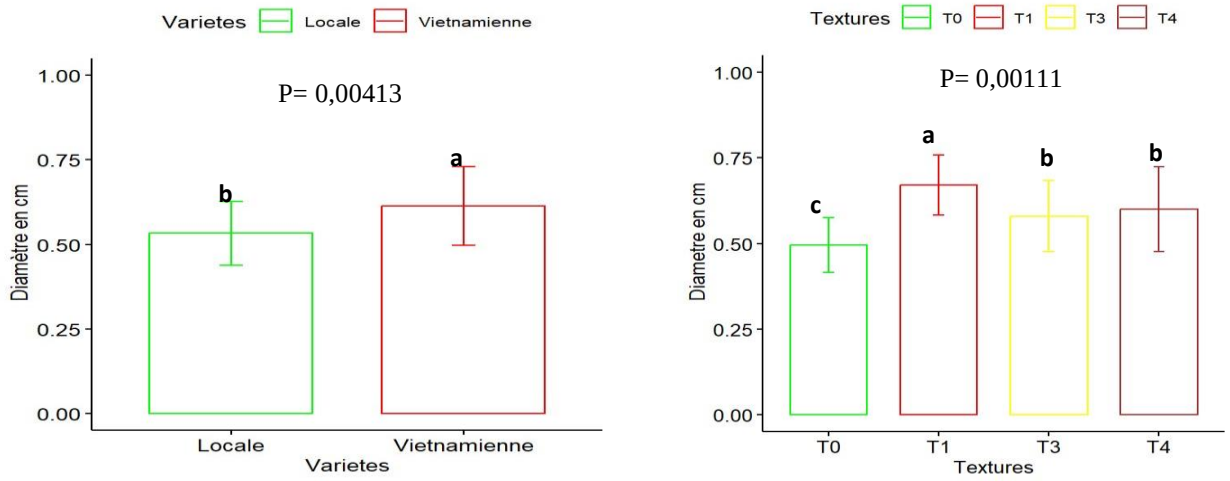

Figure 11: Variation in plant diameter depending on the **Figure 10** : Variation in plant diameter as a function of variety texture

V2 plants had an average higher number of leaves (11 leaves) than V1 plants (9 leaves) (Figure 1 2).

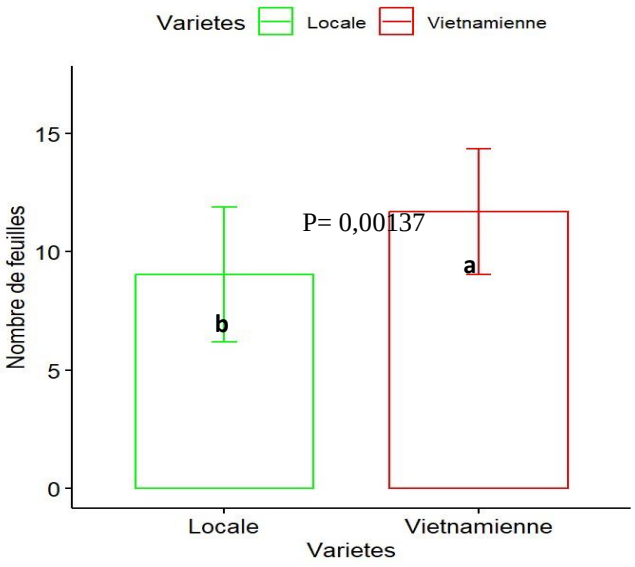

Figure 12 : Variation in the number of leaves of the plants according to the variety

3.3. Plant growth parameters by variety and substrate as a function of time

3.3.1. Plant growth by variety at 60, 75 and 90 JAS

Table 1 presents the values of the mean growth parameters as a function of variety at 60, 75 and 90 JAS. These results show that there is no significant difference between heights depending on the variety. The diameter and number of leaves vary significantly depending on the variety. Indeed, the V2 has the best averages at 75 and 90 JAS. The H/D ratio of V1 is higher than that of V2, which means that V2 has better vigor compared to V1 at 90JAS. However, the plants from both varieties have good vigour (M/D less than 80).

Table 1 : Strain Grow Parameters at 60, 75 and 90JAS

		60JAS	75JAS	90JAS	P-value
Height	V1	27±7.74 PM	27.78±7.74	28.92±7.74	ns
	V2	26.86±7.74	29.14±7.74	29.88±7.74	
Diameter	V1	0.50±0.12	0.52±0.12	0.58±0.12	0,00413
	V2	0.54±0.12	0.62±0.12	0.69±0.12	
Height/Diameter	V1	54,61	53,42	52.63±16.89	0,0425
	V2	51,41	48,18	44.35±16.89	
Number of Sheets	V1	8±2	8±2	9±2 AM	0,00137
	V2	11±2 AM	12±2 PM	12±2 PM	

3.3.2. Plant growth according to substrates at 60, 75 and 90 days ago

Table 2 shows the values of the averages of the growth parameters as a function of texture over time. Analysis of variance revealed a significant difference in height, diameter, and H/D ratio across substrates

with p-values of 0.00413, 0.0425, and 0.00137, respectively. The highest average height was obtained on T0 (30.9 cm; 32.10 cm; 31.70 ±7.74 cm respectively at 60; 75 and 90 JAS) and the lowest on T3 (23.17 cm; 24.75 cm; 26.20 cm respectively at 60; 75 and 90 JAS).

T1 has the highest average diameter at 0.61 cm; 0.65 cm; 0.77 cm respectively at 60, 75 and 90 JAS and the lowest average diameter was obtained on T0 (0.46 cm; 0.51 cm; 0.51 cm respectively at 60; 75 and 90 JAS).

The average number of leaves/plant is 12 leaves/plant on T1 substrates at 90 JAS and 9 leaves/plant on T0 substrates at 90 JAS. The H/D ratio is higher on T0 (67.49) followed by T4 (57.43) on 60 JAS. It is lower on the substrates T3 (38.95) and T1 (39.97) at 90 JAS.

These results show that the plants obtained the best vigour on T3 and T1 substrates. Plants in the T0 substrate had the lowest vigour.

Table 2. Varietal growth parameters at 60, 75 and 90 JAS

		60 JAS	75 JAS	90 JAS	P-value
Height (cm)	T0	30.9±7.74	32.10±7.74	31.70±7.74	0,000728
	T1	27.6±7.74	29.30±7.74	30.57±7.74	
	T3	23.17±7.74	24.75±7.74	26.20±7.74	
	T4	26.50±7.74	29.75±7.74	30.25±7.74	
Diameter (cm)	T0	0.46±0.12	0.51±0.12	0.51±0.12	0,00111
	T1	0.61±0.12	0.65±0.12	0.77±0.12	
	T3	0.525±0.12	0.55±0.12	0.67±0.12	
	T4	0.470±0.12	0.64±0.12	0.69±0.12	
Height/Diameter	T0	67.49±16.89	63.26±16.89	63.36±16.89	1.63e-08
	T1	45.40±16.89	44.84±16.89	39.97±16.89	
	T3	44.74±16.89	44.40±16.89	38.95±16.89	
	T4	57.43±16.89	48.46±16.89	43.93±16.89	
Number of Sheets	T0	9±2 AM	10±2 AM	9±2 AM	ns
	T1	9±2 AM	11±2 AM	12±2 PM	
	T3	10±2 AM	10±2 AM	11±2 AM	
	T4	10±2 AM	11±2 AM	11±2 AM	

4. Discussion

4.1. Germination emergence according to varieties and texture

4.1.1. Germination emergence depending on the variety

The present study revealed that germination emergence begins in the 14th JAS as already observed by Lefebvre (1966); Djaha et al. (2010). It was observed at the 14th JAS in V1 and the 15th JAS in V2.

The germination rate per variety increases with time to remain constant from the 26th JAS. The average germination time of cashew seeds, under experimental conditions, is 26 days for variety V1 and 33 days for variety V2. In total, 56.67% of emergences for the V2 variety compared to 36.67% for the V1 variety were observed. This result confirms hypothesis 1 according to which the Vietnamese variety has a higher germination rate than the local one. This result can be explained by the fact that the seed has not undergone pre-treatment or flotation testing. According to Touré *et al.* (2018), the germination rate is a function of the variety, pretreatment and position of the nuts in the soil. The shelf life of seeds (seeds) may also have an influence on germination, as shown by Lefebvre (1966) who found that the germination rate of *A. occidentale* seeds ranges from 93% to 98% in the first few months after harvest. This rate drops to 55% in the 8th month and 45% in the 12th month. The discontinuity observed at the level of germination can be explained by the fact that the seeds are not all at the same stage of physiological development at a given time, as observed by Parisot (1988) on the mango tree. In addition, the difference in germination behaviour of seeds from the two varieties is due to differences in intrinsic characteristics (Paulo *et al.* 2002; Djaha *et al.* 2010). The difference in emergence rate between varieties could be explained by the fact that the germination power of the Vietnamese variety is higher than that of the local variety. This result is in line with that of Fané (2021) who states that the origin of the varieties influences germination. The results obtained on the germination rate are superior to those of Djaha *et al.* (2010) who obtained a germination rate of 40.83 and 37.50% respectively for varieties LAX1432 and LAX2081. However, these results are lower than those of Touré *et al.* (2018), which had the highest germination rates in James (79.16%) and Henry (63.58%) and the lowest in Costa Rica (51.67%). This difference could be explained by the fact that they performed a germination and flotation test, but also by the fact that they used the same type of substrate.

4.1.2. Germination emergence as a function of texture

The first emergence was observed around two weeks after planting (14th, 15th and 16th JAS) in the T1, T0 and T3 substrates. On these dates, there was no lifting at the level of T4 until the 18th JAS and T2 at the 33rd JAS. The emergence rate according to the substrates showed the results that the highest germination rate is obtained on T0 (83.33%) and T3 (75%), followed by that of T1 (46.33%). The lowest rates were observed in Q4 (25%) and Q2 (8.33%). The shortest germination times were achieved with T0, T1 and T3 substrates. This result can be explained by the fact that T0, T1 and T3 substrates are lighter compared to T4 and T2 substrates. This is in line with the experience of Lacroix (2003) who states that *A. occidentale* prefers soft and deep soils. He also says that the soil should be sandy or well-drained. The cashew tree likes light, non-asphyxic and deep soils (Lacroix, 2003). The emergence rates obtained in T0 and T3 could be explained by the fact that seeds sown in these substrates were more likely to germinate than those sown in T1. Indeed, the seeds have not undergone any pre-treatment, which can promote unequal initial characteristics between the seeds in terms of their germination capacity. The low emergence rates obtained on T4 and T2 substrates could be explained by the fact that the heaviness of the texture does not favor emergence. The cashew tree appreciates deep, loose soils, sandy or gravelly. It is even used in the revegetation of coastal dunes to prevent erosion even if the harvest is almost nil. On the other hand, it fears the hardened horizons that prevent the penetration of the roots (Fine Media, 2017). Joker (2003) and Assih and Nenonene (2022), state that sandy

or sandy-silty soils are best suited for cashew production given the fact that they are generally deep and drain water well. The cashew tree prefers light, sandy, deep, welldrained soils composed of 25% clay (Lautié *et al.* 2001).

4.2. Plant Growth by Variety and Texture

The study showed that growth parameters vary with time ($P < 0.0001$). The type of variety has an influence on the diameter and number of leaves of the plants ($P<0.05$). The plants of the Vietnamese variety have the largest diameters with an average value of 0.61 cm compared to 0.53 cm for the local variety. Regarding the variation in plant height, there is a very highly significant difference ($P=0.000728$) between substrates. The highest height was obtained with T0 (31.57 cm) followed by T1 (29.06 cm) and T4 (28.83 cm), the lowest height was obtained with T3 (24.62 cm). The largest diameters were recorded with the T1 texture (0.67 cm) followed by T4 (0.60 cm) and T3 (0.58 cm). The smallest diameters were obtained with plants with the T0 texture (0.49 cm). In terms of vigour, the H/D ratio showed that plants with the T3 texture had the best vigour (38.95) followed by the T1 texture (39.97). The lowest vigour was obtained with plants of the T0 texture (63,36). This result can be explained by the fact that the absence of manure in T0 favours a development in height rather than in diameter of the plants, as Smirnov states *and ly.* (1977) stated that manure is a major organic fertilizer that contains all the nutrients necessary for the plant to develop. The yellowing of the leaves observed on T0 could be caused by the lack of nutrients in the substrate. The difference in diameter between varieties is explained by intrinsic characteristics of the varieties. The H/D ratio of the plants is less than 80, this situation can be explained by the fact that cashew plants less than two months old are at a period of the development cycle where growth in height is not favoured over growth in diameter (Frieden *and ly.* 2004). According to Devineau (1991), a high H/D ratio reflects a predominance of terminal growth over cambial growth and is due to a defect in energy inputs. The higher the ratio, i.e. above 80, the more thread-like and poorly maintained the plants are (Hamawa *and ly.* 2019). These results on the height are higher than those of Touré *et al.* (2018) obtained on the Benin yellow variety with the highest height of 13.97±0.32 cm at 90 JAS. The resulting leaf diameter and number are small compared to the results of Coly (2016), who obtained an average crown diameter of 0.95 cm and an average leaf count per plant of 12. The difference in growth observed between varieties may be related to the adaptive capacity of each variety, especially since the latter is more significant for Sahelian species during the first phases of growth (Ado, 2017).

5. Conclusion and perspectives

This study made it possible to evaluate the germination and growth parameters of two varieties of cashew trees of different origins and to know the best substrate for these parameters. The results show that the origin of the seed has an influence on the germination and growth of cashew plants depending on the soil texture. The seeds of the Vietnamese variety sown naturally gave a more interesting emergence rate than the local variety. This difference confirms hypothesis 1 that the Vietnamese variety has a higher germination rate than the local variety. The highest emergence rate was recorded on the substrate (T3) for the Vietnamese variety and on the T0 for the local variety; which confirms hypothesis 2 according to which the Vietnamese variety adapts better to the sandy-clay texture (T3).

The best substrates favourable for good plant development are sandy-clay substrate (T3) and sandy substrate (T1) in which the plants showed better vigour (M/D less than 80). In short, the best vigour was obtained with the Vietnamese variety and the sandy-clay substrate (T3), confirming hypothesis 3 that plant growth and development are better in the Vietnamese variety.

However, further studies should be undertaken on:

- the effect of irrigation on the germination and growth of cashew varieties;
- the effect of temperature on the growth of cashew plants in nurseries;
- monitoring plantations and pathogen attacks of the Vietnamese cashew variety in Senegal; • the effect of grafting local and Vietnamese varieties on plant growth and development;
- the effect of clay dose on the germination and growth of cashew varieties in Senegal.

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