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Comparative study of the agromorphological performances of different types of plant propagation material from three varieties of plantain banana (*Musa sp.*)

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ABSTRACT
Objective: The aim of the present study was to assess the morphological performance of plant material from plantain varieties in order to select the most efficient in Tiassalé locality.
Methodology and results: A research program involving three types of plant material (sucker, vivoplant, and vitroplant) from three popularized varieties (Orishele, Corne-1, and Pita-3) was carried out at Tiassalé, precisely at M'Brimbo in Côte d'Ivoire. The experimental design used was a two-factor split plot, the main factor being the type of plant material, and the secondary factor the variety. Data were collected on the number of leaves, the pseudostem height and diameter, the leaf length and width. Results from analysis of variance revealed that in vitro plant was superior for the number of leaves for the three varieties. For the height of the pseudostem, value was high with the sucker of Corne-1 and Orishele varieties, unlike Pita-3 variety in which the in vitro plant recorded the greatest height.
Conclusion and application of findings: At the end of this study, most efficient type of material of each variety was suckers for Corne-1 and Orishele varieties, and vitroplants for Pita-3 variety. The type of material that performs well in each variety can be used in genetic improvement programs to increase yield and obtain superior quality fruit to achieve food self-sufficiency. Compared to the suckers of Corne-1 and Orishele, in vitro plantlets of Pita-3 should therefore be promising in the popularization of this variety.
Keywords: Banana tree, Varieties, Types of plant material, Agromorphological performances.

INTRODUCTION
Banana (*Musa sp.*), a food plant, is highly valued by most of the planet's population (Jenny *et al*., 2003). Native to the Far East, in Southeast Asia in the Malay Archipelagos and the Philippines, banana tree is a giant plant (Bonnet, 2012) grown for its fruit representing one of the most important crops in the world (Bakry *et al*., 2002). Bananas are a vital food resource for more than 400 million inhabitants of intertropical zones (Lassois *et al*., 2009) and

it generate an important source of income for producing countries (Tchango & Ngalani, 1998). Plantain bananas world production was estimated at 43,116,591 tons in 2020 (FAO, 2022). In Côte d'Ivoire, the banana sector ranks third in food production after yams and cassava (FAO, 2016). It provides approximately 28,000 direct and indirect jobs. With a consumption of 80 to 120 kg/inhabitant/year (Bomisso *et al*., 2018), Ivorian production is approximately 1,9 million tons (FAO, 2022), making Côte d'Ivoire the 8th largest producer in the world. From fruits to pseudostem and leaves, banana plays a role in food and even in herbal medicine (Rabbani *et al*., 2001; Tchigossou *et al*., 2019). The production of this foodstuff is therefore necessary. Despite this importance, production remains low to cover the needs of the constantly growing population (Yao *et al*., 2014; Thiémélé *et al*., 2017). This low productivity of banana plantations is mainly due to the use of banana as a secondary crop in traditional production systems, the scarcity of plantain monoculture systems and the poor practice of agricultural techniques. Kwa and Temple (2019) declared that new techniques for the mass production of plant material especially the technique of seedlings derived from stem fragments, have made it possible to obtain planting material, which is indeed a major constraint in the case of vegetative propagated production. The use of improved cultivation techniques, the establishment of plantain monoculture systems, and the creation of more resistant and more productive varieties are necessary to overcome this low production. In this context to improve agricultural yields, the World Agroforestry (ICRAF) implements and offers farmers farming strategies and techniques. Indeed, natural multiplication of plantain banana tree does not enable to obtain a large number of suckers in view to create large homogeneous farms. Therefore, rapid multiplication techniques were put in place. These rapid multiplication techniques, macro, and micro-propagation, allow to gain vivoplants and vitroplants. These two techniques produce large numbers of new plants compared to natural propagation and they provide healthy plant material free of any disease. Various studies on plantain banana tree have been carried out on pathologies, varietal selection and plant description (Anno, 1981; Kouamé *et al*., 2014; Tchigossou *et al*., 2019) such as the growth of vegetative and reproductive system, which has been studied in detail for many years. In the modelling domain, studies permitted to develop some plantain banana growth models. Indeed, Kouamé *et al*. (2014) worked on the growth of the plantain banana in the regions of Yamoussoukro and Azaguié in Côte d'Ivoire. Models regarding banana and plantains growth was also assessed by Tchigossou *et al*. (2019) in southern Benin on two cultivars from two areas to evaluate their growth through certain agromorphological parameters. Sidibé *et al*. (2020) worked on the agro-morphological characteristics of some banana hybrids (*Musa sp*.) in Cameroon. Nguetta *et al*. (2016), and recently Marie-Laure *et al*. (2021) conducted a study about the nitrogen-potassium fertilizers effect on the development and the production factors of plantain tree in Côte d'Ivoire. However, little data exist on the evaluation of different types of plantain banana planting material in farms involving suckers, vivoplants, and vitroplants from the same varieties with the aim of promoting them. It is in this context that a study to compare the morphological parameters of plantain cultivars was initiated. The general objective of this work aimed to evaluate the morphological performance of three types of plant material from three varieties of plantain banana at M'Brimbo in Côte d'Ivoire.

MATERIAL AND METHODS

Experimental site: The study was conducted in Côte d'Ivoire precisely at M'Brimbo, a village in the prefecture of Tiassalé located about 138 km from Abidjan on the Northern Highway (Figure 1). Tiassalé (Southern Côte d'Ivoire) has geographical coordinates of 5°54 N and 4°50 W characterized by an Attean type climate and an annual rainfall of 1287 mm (Climate-Data.org, 2019), with a minimum of 39.83 mm in January and a maximum of 156.48 mm in June. The economic assets are favourable to commercial and industrial exchanges. Characterized by good rainfall and ferralitic soil, Tiassalé is propitious for banana cropping allowing it to be qualified as a town with an agricultural vocation.

Figure 1: Experimental site

Plant material: The plant material constituted of three types (sucker, vivoplant, and vitroplant) produced each from the three varieties of plantain banana (Pita-3, Orishele, and Corne-1). These three varieties were used for their different characteristics which are resistance to disease, organoleptic characteristics, and appreciation by consumers. The types of material used come either from Azaguié (suckers of the Corne-1, Orishele, and Pita-3 varieties, including the vivoplants of the Corne-1 variety), from the National Center for Agronomic Research (CNRA) (vivoplants of Pita-3 and Orishele varieties), and from the ICRAF Somatic Embryogenesis Laboratory (vitroplants of all varieties).

Methods

Experimental design: The trial design was a split plot with three replications. The type of plant material was the principal factor, and the secondary one was the variety. Each elementary plot includes only a 15-tree line of banana trees. The trees are 2 m apart on the line and 2 m between the lines for a total of 27 elementary plots.

Conduct of the trial: The plot was cleared before planting the plantlets. Once clearing was completed, cubic holes of 40x40x40 cm were made for transplanting the plantlets (Sebuwufu *et al.*, 2005). The maintenance of the plot was carried out by manual weeding two times a month. This weeding began one month after planting the plantlets. The maintenance of the banana trees mainly consisted of removing dead leaves hanging from the trees and manual watering if necessary.

Data collection: Data collection begun one month after planting of the banana plantlets. It was carried out using the banana agronomic descriptor of IPGRI/INIBHP/CIRAD (1996), and Tchigossou *et al*. (2019) works. This descriptor permitted to retain the following parameters: number of leaves, pseudostem height, pseudostem diameter, leaf length, leaf width, and the growth rate of the pseudostem for analysis. The leaf count made it possible to gain the number of leaves of the plantain banana plantlets. The leaves counted were the open leaves and not the cigar leaves. Counting was done from the bottom of the plant upwards. To quantity the height of the pseudostem, a measuring tape was used, starting from the base of the pseudostem (collar) to the top of the plant at the level of the V formed by the last two functional leaves. The pseudostem diameter was performed with a calliper ten (10) cm above the ground. Leaf length was collected with a tape measure from the base of the petiole to the top of the leaf, and leaf width was measured with a tape measure at the level of the greatest width. The growth rate of pseudostem height was determined in cm/day at 95 and 125 days after planting (DAP). The following formulas were used to calculate this speed on the dates indicated:

Speed 1 = $(h_2 – h_1)$ / (95 DAP- 65 DAP)

Speed 2 = $(h_3 – h_2)$ / (125 DAP- 95 DAP)

with h = pseudostem height.

Data analysis: Data collected were processed with Excel 2019, and an analysis of variance was performed with the Genstat Discovery Edition 4 software. The Bonferroni test at the 5% threshold was used to compare means. Relationships between parameters were assessed with linear; polynomial, and logarithmic correlations.

RESULTS

Morphological growth parameters

Number of leaves: Analysis of the number of leaves for Corne-1 showed that this parameter for the vitroplant is significantly higher than that of the sucker and the vivoplant at 65 days after planting (DAP) (Table 1). However, between 95 and 125 DAP, this parameter did not differ significantly from one type of plant material to another. The number of leaves increased positively over time. At 125 DAP, the highest number of leaves was obtained with the sucker plant material (9.18±2.04) while the lowest number was observed with the vivoplant (8.15±1.68).

Table 1: Number of leaves of the Corne-1 variety according to three types of plant material.

Plant material type	65 DAP	95 DAP	125 DAP
Sucker	5.24 ± 0.28 b*	7.85 ± 1.25a	9.18 ± 2.04a
Vitroplant	7.85 ± 0.66a	7.76 ± 0.53 a	8.88 ± 1.65 a
Vivoplant	5.55 ± 0.69 b	6.97 ± 0.92a	8.15 ± 1.68 a
Means	6.21	7.53	8.74
LSD	0.83	1.68	1.63
CV (%)	5.9	9.8	8.2

*In the same column, the means followed by the same letter are statistically identical at 5% according to the Bonferroni test.

Analysis of the number of leaves produced by the Pita-3 variety showed no significant difference at 65 DAP between the vitroplant and the vivoplant (Table 2). However, the number of leaves emitted by the sucker is lower than those of the vitroplant and the vivoplant. A meaningful variance occurred between the sucker and the other both types of plant material. At 95 DAP, the number of leaves produced by the vitroplant was higher and significantly different from the sucker and the vivoplant. However, at 125 DAP, no significant difference existed between the different types of material of the Pita-3 variety. At this date, the number of leaves was higher for the vitroplant (9.61±1.77) compared to the vivoplant.

Table 2: Number of leaves of the Pita-3 variety according to three types of plant material.

Plant material type	65 DAP	95 DAP	125 DAP
Sucker	3.94 ± 0.29 b*	6.33 ± 0.82 c	8.21 ± 2.27 a
Vitroplant	6.91 ± 0.51 a	8.03 ± 0.41 a	9.61 ± 1.77 a
Vivoplant	6.06 ± 0.88 a	6.64 ± 0.95 b	8.09 ± 2.51 a
Means	5.64	7.00	8.64
LSD	1.02	1.08	2.73
CV (%)	8	6.8	13.9

*In the same column, the means followed by the same letter are statistically identical at 5% according to the Bonferroni test.

The analysis of the number of leaves produced by Orishele variety revealed that vitroplants produced significantly more leaves than the vivoplants and the suckers at 65 DAP (Table 3). At 95 DAP, the number of leaves were identical for the suckers and vitroplants. Each of them scored significantly higher number of leaves than the vivoplants. At 125 JAP, there was no difference between the different types of plant material.

Table 3: Number of leaves of the Orishele variety according to three types of plant material.

Plant material type	65 DAP	95 DAP	125 DAP
Sucker	5.24 ± 0.55 b*	7.97 ± 1.24 a	8.64 ± 192 a
Vitroplant	7.2 ± 4.2 a	7.27 ± 0.66 a	8.88 ± 1.52 a
Vivoplant	3.48 ± 1.21 c	4.33 ± 1.63 b	5.06 ± 2.04 a
Means	5.28	6.53	7.53
LSD	1.13	1.93	2.83
CV (%)	9.4	13.1	16.6

*In the same column, the means followed by the same letter are statistically identical at 5% according to the Bonferroni test.

Leaf length: At 65 and 95 DAP, the three types of plant material (suckers, vitroplants, and vivoplants) recorded leaf lengths, which differ significantly from each other for the Corne-1 variety (Table 4). However, at 125 DAP, all types of banana plant propagation material did not vary meaningly. Throughout observations, leaf length constantly increased positively for all material types. The longest leaves were observed in the suckers (81.12 ± 28.36) against a short leaf length for the vivoplants (58.09 ± 31.37).

Table 4: Leaf length of the Corne-1 variety according to three types of plant material

Plant material type	65 DAP	95 DAP	125 DAP
Sucker	47.12 ± 1.75 a*	62.59 ± 8.88 a	81.12 ± 28.36 a
Vitroplant	34.00 ± 4.29 b	50.36 ± 2.26 b	70.36 ± 23.76 a
Vivoplant	25.15 ± 3.67 c	39.42 ± 8.10 c	58.09 ± 31.37 a
Means	35.42	50.79	69.86
LSD	4.88	8.21	23.27
CV (%)	6.1	7.1	14.7

*In the same column, the means followed by the same letter are statistically identical at 5% according to the Bonferroni test.

From 65 to 125 DAP, no significant difference was observed between the leaf lengths (Table 5) of the different types of plant material of Pita-3 variety. However, the longest leaves in absolute value were observed in the vitroplant (89.25 ± 32.45 cm) and the shortest leaves in the vivoplant (65.83 ± 32.67 cm) at 125 DAP.

Table 5: Leaf length of the Pita-3 variety according to three types of plant material

Plant material type	65 DAP	95 DAP	125 DAP
Sucker	41.91 ± 2.53 a*	57.73 ± 8.38 a	75.02 ± 31.50 a
Vitroplant	39.06 ± 8.50 a	60.82 ± 18.40 a	89.25 ± 32.45 a
Vivoplant	33.73 ± 7.81 a	46.20 ± 13.20 a	65.83 ± 32.67a
Means	38.23	54.92	76.70
LSD	8.27	11.39	19.87
CV (%)	9.5	9.2	11.4

*In the same column, the means followed by the same letter are statistically identical at 5% according to the Bonferroni test.

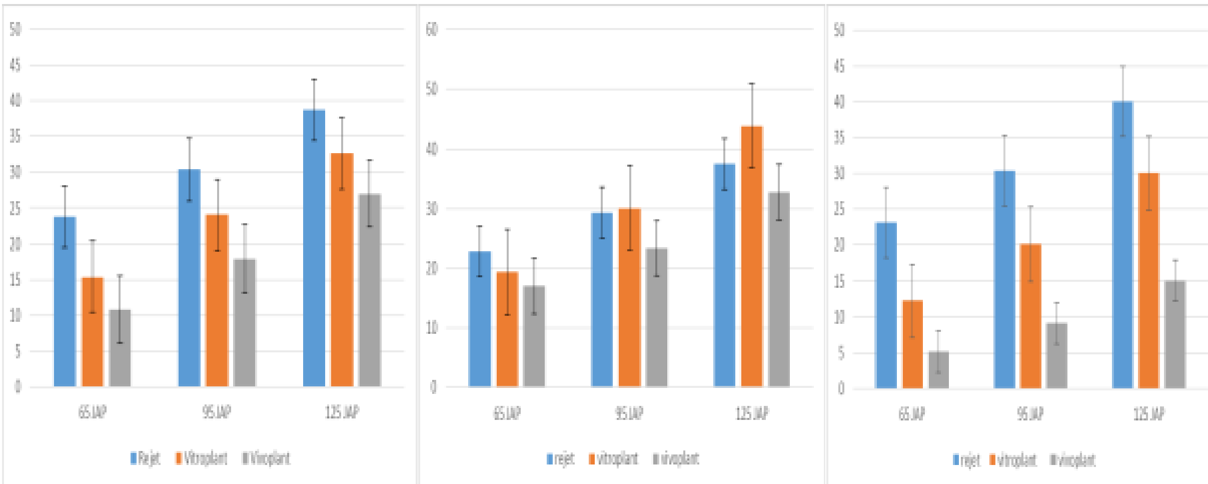
Table 6 showed that significant differences existed between the leaf lengths of the three types of plant material of the Orishele variety from 65 to 125 DAP. The longest leaves were observed in the suckers (82.58 ± 29.93) against shorter leaf length in the vivoplants (31.73 ± 30.15) at 125 DAP.

Table 6: Leaf length of the Orishele variety according to three types of plant material

Plant material type	65 DAP	95 DAP	125 DAP
Sucker	46.92 ± 2.63 a*	63.33 ± 11.21 a	82.58 ± 29.93a
Vitroplant	29.32 ± 5.65 b	43.90 ± 6.03 b	62.85 ± 19.27ab
Vivoplant	12.62 ± 5.15 c	20.67 ± 9.52 c	31.73 ± 30.15 b
Means	29.62	42.63	59.05
LSD	4.97	9.03	24.89
CV (%)	7.4	9.3	18.6

*In the same column, the means followed by the same letter are statistically identical at 5% according to the Bonferroni test.

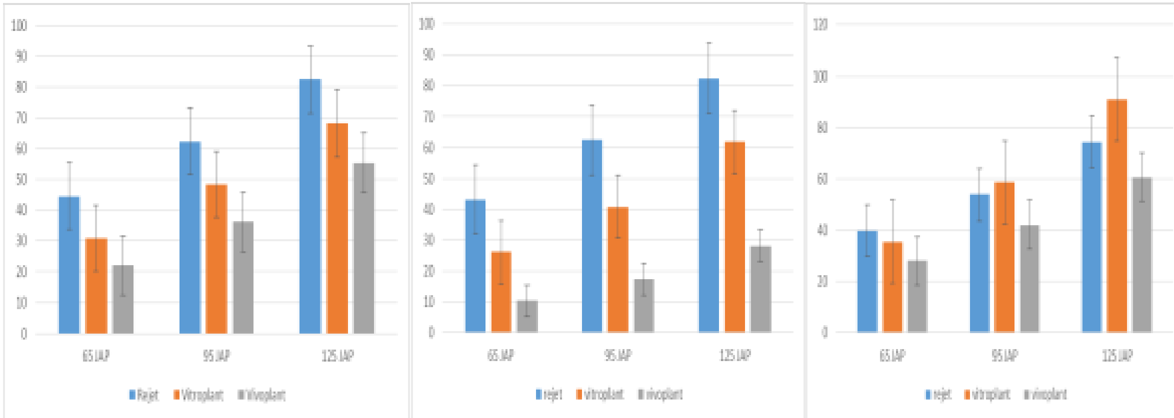
Leaf width: From 65 to 95 DAP in Corne-1, evolution of the leaves showed large leaves in the suckers which were significantly greater than those of the vitroplants and the vivoplants (Figure 2) but no significant difference at 125 DAP was observed. Leaf width steadily increased across all material types. The widest leaves in absolute value were scored by the suckers and the narrowest by the vivoplants. In Pita-3 variety, no significant difference was observed between the suckers, the vitroplants and the vivoplants from 65 to 125 DAP for the leaf width (Figure 2). At 125 DAP, in absolute value, leaf width was higher with the vitroplants (43.85 ± 14.81) compared to the vivoplants (32.82 ± 16.49). Orishele variety exhibited for the suckers wider leaves than those of the vitroplants and the vivoplants from 65 DAP to 125 DAP. Leaf width increased steadily over time. After 125 DAP, the leaf width was high with the suckers while the lowest width was observed with the vivoplants.



Corne-1 Pita-3 Orishele

Figure 2: Leaf width of plantain varieties

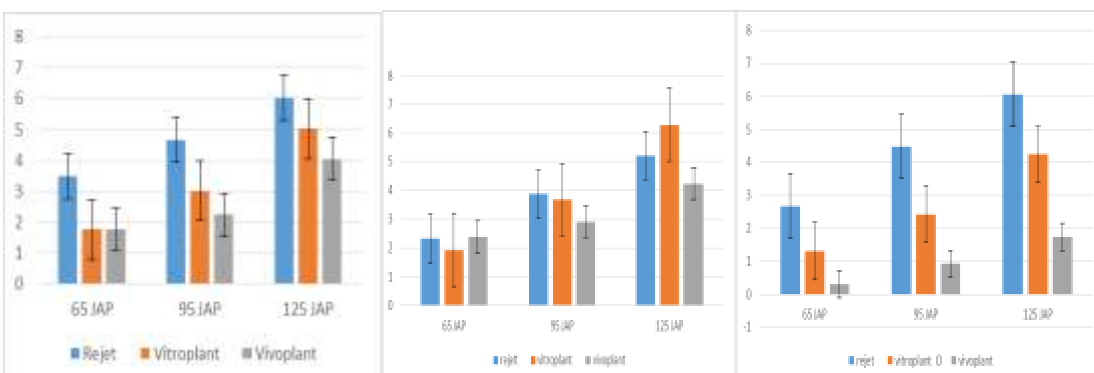
Pseudostem height: In Corne-1 variety, from 65 to 125 DAP, the height of the suckers' pseudostem was significantly higher than those of the vitroplants and the vivoplants (Figure 3). The highest height at 125 DAP was recorded by the suckers (82.37 ± 37.66) against a low height scored by vivoplants (55.43 ± 36.27). From 65 to 125 DAP in Pita-3 variety, the height of the pseudostem did not showed difference among the types of plant materials (Figure 3). In absolute values, the highest height was observed with the suckers and the lowest with the vivoplants. The height of the pseudostem in Orishele, from 65 to 125 DAP, was significantly higher in suckers than in vitroplants and vivoplants (Figure 3). The highest height was observed in suckers (82.36 ± 35.81) compared to vivoplants (28.04 ± 31.61).



Corne-1 Pita-3 Orishele

Figure 3: Pseudostem height of plantain varieties

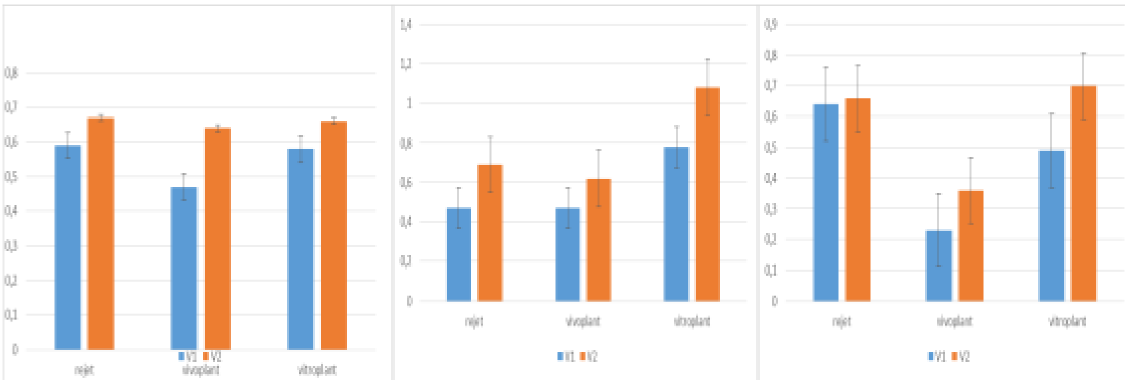
Pseudostem diameter: The Corne-1 variety showed no significant difference between the types of plant materials for this parameter at 65 DAP (Figure 4). However, at 95 DAP, the pseudostem diameter of the suckers was significantly greater than those of the vitroplants and vivoplants. In addition, no difference was observed in the different types of material at 125 DAP. Concerning Pita-3 variety, from 65 to 125 DAP, the diameter of the pseudostem did not show any difference among the types of plant materials (Figure 4). Nevertheless, the highest diameter was detected in the vitroplants (6.28 ± 3.13) and the lowest in the vivoplants (4.22 ± 2.59). Pseudostem diameter increase occurred over time. Concerning Orishele variety, suckers recorded diameter significantly greater than those of the vitroplants and the vivoplants from 65 DAP to 125 DAP (Figure 4). At 125 DAP, the highest diameter was obtained with the suckers (6.07 ± 2.65) while the lowest was observed with the vivoplants (1.73 ± 2.15).



Corne-1 Pita-3 Orishele

Figure 4: Pseudostem diameter of plantain varieties

Growth rate of pseudostem height: Regarding Corne-1 variety, the growth rates ($Speed_1$) of the suckers and vitroplants were statistically identical and significantly higher than that of the vivoplant (Figure 5). At 125 DAP, the calculated speeds $Speed_2$ did not differ significantly from one type of plant materials to another. Concerning Pita-3 variety, the growth rate $Speed_1$ was identical in suckers and vivoplants but statistically lower than that of vitroplants (Figure 5). Additionally, the growth rate $Speed_2$ of the vitroplants was higher than those of the suckers and vivoplants. According to Orishele variety, vivoplants had a significantly lower growth rate $Speed_1$ than those of vitroplants and suckers (Figure 5). However, the growth rate $Speed_2$ of vitroplants was higher with a significant difference with that of the vivoplants.



Corne-1 Pita-3 Orishele

Figure 5: Pseudostem growth rates of each material type by variety

Relationships between parameters: At 125 DAP; types of plant materials studied had no significant effect on the studied parameters, namely the number of leaves per plant, the pseudostem diameter and height, the leaf length and width. More information led us to determine the relationships that exist between parameters of two types of bananas specifically the Orishele sucker and the Pita-3 vivoplant. Three groups of correlation were identified: linear, polynomial, and logarithmic correlations. Linear correlations on the one hand happened between the diameter and the height of the pseudostem (Figures 6 & 7) and on the other hand between the leaf width and the leaf length (Figures 8 & 9) of the vivoplant of Pita-3 and the sucker of Orishele varieties. Additionally, a polynomial trend line of order 2 with a bump was detected between the diameter of the pseudostem and the number of leaves of Orishele suckers (Figure 10). The coefficient of determination of this curve with the value 0.95 was a proof that there was a good correspondence between the pseudostem diameter and the number of leaves observed and the curves. A logarithmic trend line was also perceived between pseudostem diameter and the number of leaves in the vivoplants of Pita-3 variety (Figure 11).

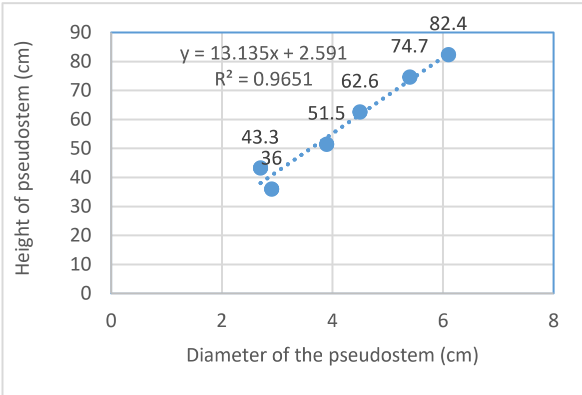


Figure 6: Linear correlation between the diameter and the height of the sucker from Orishele

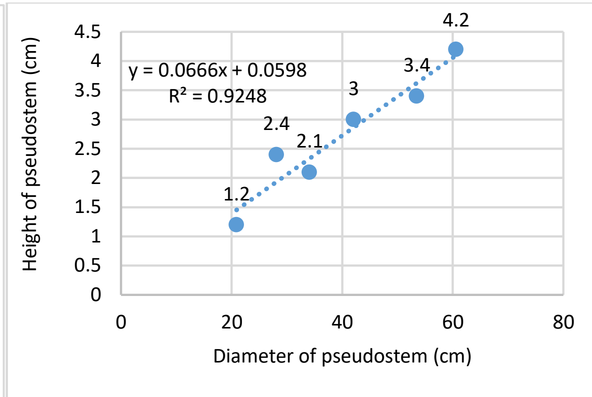


Figure 7: Linear correlation between diameter and height of vivoplant pseudostem from Pita-3

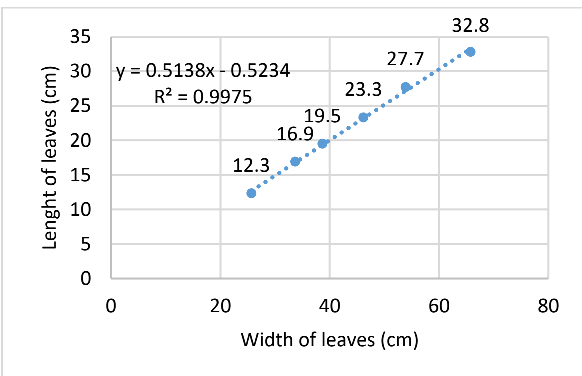


Figure 8: Linear correlation between leaf width and leaf length of vivoplant from Pita-3

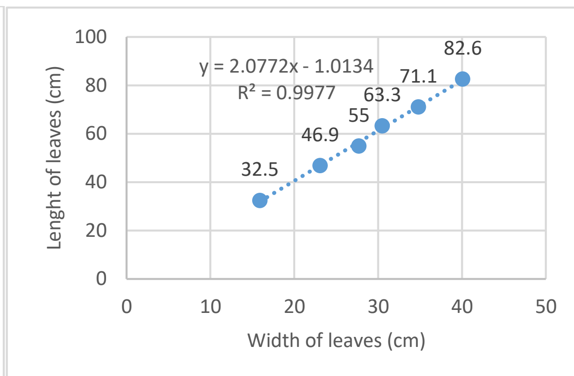


Figure 9: Linear correlation between leaf width and length of sucker from Orishele

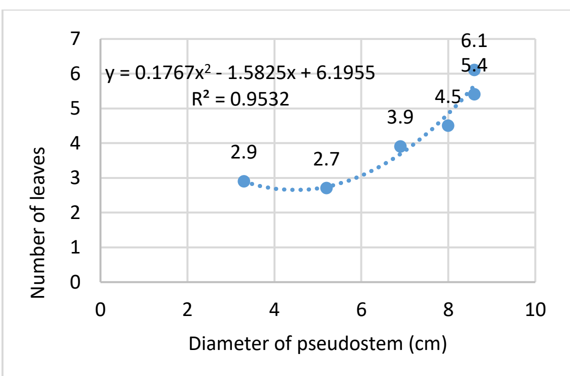


Figure 10: Polynomial correlation between pseudostem diameter and number of leaves of sucker from Orishele

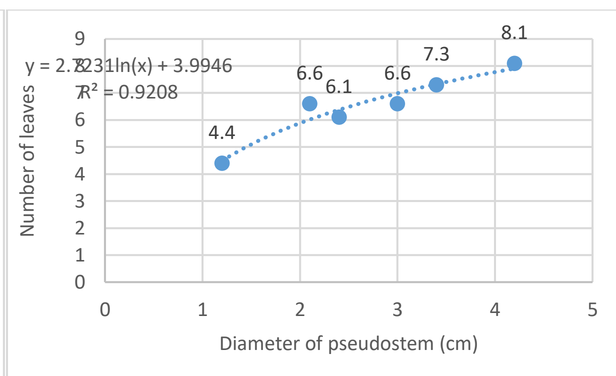


Figure 11: Logarithmic correlation between the diameter of the pseudostem and the number of leaves of the vivoplant from Pita-3

DISCUSSION

Morphological parameters: Growing is a natural happening of intensifying size over time, implicating the manifestation of new tissues (Marie-Laure *et al*., 2021). Results obtained showed significant differences from one type of plant material to another according to the plantain banana variety. This is in line with results of Kouamé *et al*. (2014) and Tchigossou *et al*. (2019). Regarding Corne-1 variety, the tissue culture plant (vitroplant) was the type of material that had the highest number of leaves from 65 to 125 DAP. Moreover, for the pseudostem height and diameter, leaf length and width, the type of material that showed good values was the sucker, followed by the vitroplant, and the vivoplant. Boye *et al*. (2010) showed that by studying the agronomic performance of Musa AAB cv Corne-1 plantains from dehydrated bayonet suckers and scale suckers for one month, the dehydration technique does not alter the growth parameters of the banana tree. Kouamé *et al*. (2014) also, indicated that differences obtained in the height of pseudostem could be explained by differences in environmental conditions, soil types, nature and volumes of fertilizer input used and/or cultivars. Moreover, according to Turquin (1998) and Tchigossou *et al*. (2019), the pseudostem of the banana tree results from foliar interweaving, and this could explain the discontinuity observed in the evolution of the circumference throughout the growth of the plant. For Pita-3 variety, the number of leaves in the vitroplant and the vivoplant were statistically equal but significantly higher than that of the sucker at 65 DAP. The same trend was observed at 95 DAP where the number of leaves produced by the vitroplant was significantly higher than those of the sucker and the vivoplant. Additionally, the pseudostem height, leaf length and width did not show any significant difference at all observation dates. In general, all types of plant material of Pita-3 variety had good growth. This could be enlightened by the fact that this variety is naturally resistant to Sigatoka disease. This resistance acquired by Pita-3 in its genomic composition, is due to Calcutta 4, which is one of Pita-3 progenitors also resistant to Sigatoka (Fullerton & Olsen, 1993). From 65 DAP to 125 DAP; the vitroplant was the type of plant material that had the highest values, followed by the sucker and the vivoplant. However, data obtained during the three observation dates were not significantly different showing no suitable type of plant material. This study findings are comparable to those of Sadom *et al*. (2010) who mentioned no substantial difference in plantain banana about pseudostem height. In Orishele, variety at 65 DAP, the number of leaves was significantly high for vitroplant compared to the vivoplant and the sucker. Regarding the pseudostem height, the leaf length and width, high values recorded by the sucker at all observation dates were highlighted. These values significantly higher than those of other types of material for this variety could be explained by the good growth that took place at the level of all types of plant material.

Relations between the morphological parameters: The study of the relationships between the different parameters of plantain banana highlighted three groups of correlation such as linear, logarithmic, and polynomial correlations. The linear correlations that exist between the height and the diameter of the pseudostem and between the leaf length and leaf width of the sucker of Orishele and the vivoplant of Pita-3 show the strong growth that took place at the level of these different banana plant propagation materials. The various coefficients of determination close to 1 indicated a very good relationship between the measured data and the curves displayed in the results. These results corroborated those of Ongagna *et al*. (2016) who mentioned that regardless of the substrate used, the different banana plants produced by the plant stem fragment technique show a strong correlation between height and diameter of the pseudostem. Furthermore, a logarithmic correlation exists between the number of leaves and the pseudostem diameter of the vivoplant of Pita-3. The coefficient of determination (0.92) indicated very good relationships between the observed data and the trend curves. This type of correlation provides information on the ability of this type of plant material of the Pita-3 variety to grow very rapidly at the beginning of the crop cycle to reach optimal dimensions in terms of growth and development parameters, because these plants have not been influenced by environmental factors such as high or low temperature, abundance of water due to heavy rains and wind. These results are identical to those of Mazinga *et al*. (2012) who obtained with the vitroplant of FHIA-01 variety an increasing evolution during all the period of observation in field. The polynomial correlation between the number of leaves and the diameter of the pseudostem of the Orishele sucker reflects the weak growth of plants that were not yet adapted to the environment at the starting of the crop cycle and that the enlargement of the pseudostem depends in part on the number of leaves emitted by the banana tree. The values of the coefficients of determination are greater than 0.95. The data obtained are therefore sufficiently reliable to predict the growth of the different cultivars of plantains. These results agreed with the writings of Lassoudière (1978), Anno (1981), Turquin (1998), and Tchigossou *et al*. (2019), who attested that the pseudostem of the banana tree which results from leaf imbrication would explain why the circumference did not positively evolve throughout of plant growth.

CONCLUSION AND APPLICATION OF RESULTS

The comparison of the agromorphological parameters at the vegetative stage of each of the varieties showed a good development of suckers from fields in the Corne-1 and Orishele varieties, while in the Pita-3 variety, it was the vitroplant, which excelled. This development allows plantain suckers to occupy first place respectively for each of the Corne-1 and Orishele varieties in terms of ranking, followed by vitroplant and vivoplant. In Pita-3 variety, the vitroplant was the most efficient, followed by the sucker and the vivoplant. The type of material that performs well in each variety can thus be used in genetic improvement programs to increase yield and obtain better quality fruit. These good performances obtained were influenced by reducing the leaves size sometimes during the growth of these types of plant materials infected by the Sigatoka disease and the Banana Bunchy Top Virus (BBTV). Controlling these growth disorders by providing resistance genes to these different types of materials could prove necessary in improving their performance and increasing their yield. The growth of plantain is complex; and this complexity can be capitalized by exact simulations from the modelling of plantain development and make it possible to predict it. Therefore, the reproduction of this work over several crop cycles in various zones would permit to better value this study conclusions.

Conflict of Interest: Authors declare that there is no conflict of interest.

Data availability: Data will be made available upon request.

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