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Influence of Planting Techniques from Stem Fragments (PIF) in Relation To Plantain (*Musa Sapientum* L.) Cultivar Types on Rejection Power in Gbadolite, Democratic Republic of Congo

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ABSTRACT

The purpose of this study is to evaluate the influence of PIF in relation to the types of plantain trees in Gbadolite in the Democratic Republic. The experimental set-up used was that of complete randomized blocks with 3 treatments (T1: French; T2: True Horn; T3: False Horn) and 3 replications. Weaned per cormus, 44 rejects; 32 rejects and 30 rejects respectively for the French, True Horn and False Horn types. The French type gave more weaned offspring than the true and false horn types under Gbadolite conditions. In short, thesecond hypothesis is confirmed. Therefore, the french type responds to this technique than the other types.

Introduction

Currently, plantain is placed among the commonly consumed products such as rice, wheat and maize, all of which occupy the important ranks of food crops in terms of gross production value. In terms of world production, banana is the fourth agricultural product after rice, wheat and corn. It constitutes the basis of food security for many populations. Cultivation systems are very diversified throughout the world and the objectives vary: self-consumption, sales on local or national markets and export[1].

This crop is also an important source of food for the populations of African countries and has become an axis of great socioeconomic importance from the point of view of food security and job creation[2].

Moreover, bananas are undoubtedly among the most important tropical fruits, and more than 400 million people in 120 developing countries depend on bananas, both as a staple food and as an important product for local and international trade, a source of income for all rural populations in the humid tropics of Africa[3].

However, the plantain is primarily a food crop grown for its high-energy fruit, which can be eaten fresh or cooked and provides a very large supply of nutritious food rich in carbohydrates, minerals and vitamins that can fill nutritional gaps[4].

In the Democratic Republic of Congo, bananas and plantains are the second most important self-consumed crop in relation to other crops and contribute greatly to the food security of the population. The production of bananas and plantains in the DR Congo ranks 10th in the world. In terms of other food products, their production is second only to cassava[5; 6]. In addition, bananas and plantains play a role in improving the income of the population because of their high market value[7].

In North Ubangi and more specifically in Gbadolite, bananas occupy a significant place among food crops and come in eighth place after maize, groundnuts and cassava. It is a source of food, alcoholic beverages, and income through the marketing of the bunches[8].

However, access to good quality and significant quantity of releases is one of the major constraints when establishing a plantain crop [9; 10; 11].

Indeed, in view of the continuous demand for this commodity and the scarcity of the availability of rejects, several related studies have been carried out, in particular the experimentation of true decapitation and false decapitation techniques in order to produce rejects[5]. Observation of the effect of flaming on the rejecting power of some plantain cultivars[11; 12].Proliferative potential analysis of six banana cultivars by macro propagation[13].Evaluation of the FIP technique to circumvent the planting material problem[14]. Assessment of the influence of the use of different substrates and buckling on the rejection power of plantai[12].

In view of the above, it was observed that the predecessors did not address a problem related to the influence of the PIF technique (Plants from Stem Fragments) in relation tocultivar types; therefore, this study observed the

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effect of this technique on the rejection power of plantain types under the agricultural conditions of Gbadolite.

For this reason, this study seeks to answer the main question as to whether the PIF technique can influence rejection in proportion to the cultivar types of banana trees under the agro-ecological conditions of Gbadolite.

Specifically, to answer the questions of whether cultivar types respond differently to the FIP technique. Which cultivar type can produce large numbers of offshoots by applying this technique?

This study tested the main hypothesis of whether the PIF technique would influence rejection in relation to plantain cultivar types. Specifically, to observe if the rejection power would be proportional to the types of plantains and if the French type would have a higher rejection power than the other types of plantains in the agro-ecological conditions of Gbadolite.

The overall objective of this work was to study the influence of the PIF technique in relation to the types of plantains on the rejection power.

Materials and methods

Study environment

The experimental field was installed in the town of Gbadolite, commune of Gbadolite, district Lite, cell of Gbawele in the province of North-Ubangi in the Democratic Republic of Congo. The geographical coordinates of the experimental field indicated by GPS: Latitude: 04°17'00436'North, Longitude: 21°00'4722' East, Altitude: 403 m. The research covered a period of 122 days or about 4 months of experimentation.

The city has an Aw_2 type climate according to Koppen's classification. The soil is clayey-sandy, the rainfall is relatively abundant with an annual average of more than 1600 mm, i.e. an estimated 1800 mm. The insolation is low, 45% of total tropical energy radiation[15 ; 16].

The vegetation there consisted of equatorial evergreen rainforest. Under anthropogenic action, it is currently made up of savannas where we find: Imperata cylindrica, Penisetum sp, Chromolaena odorata, Panicum maximum. The dominant vegetations are the savannah and the equatorial forest which abound in several types of species of fauna and flora, and formed plateaus, hills and wooded savannah towards the South. The city is crossed by several rivers among which the most important are Boyi, Nzekele, Wakamba, Waka and Nzanguma, Ngandanga, Wambe, Mboroki-mbondo and Sokoro[11].

Materials

Figure 1 shows the types used in this study.

Figure 1. Mwasi-moindo (French type 1); Ngbangele (Faux horn type 2) and Mosantu (True horn type).

The biological materials used in this study were plantain offshoots of three types of cultivars from farmers' fields. The choice of the cultivars within the types is due to their preference by the local farmers, by the consumers and their economic value.

Methods

Experimental set-up

The experimental device used, was that of the randomized complete blocks; having 3 blocks and 3 treatments notably T1: French type; T2: true horn type; T3: false horn. The surface area of the propagator: 9.75 m2 (6.5 m long and 1.5 m wide), 60 cm high; with plots (rows) 50 cm apart and the blocks separated by a 10 cm thick masonry wall. This was built under a shed 1.50 m high.

Fragments were transplanted at 20 cm x 20 cm spacing, with 10 fragments per plot (row), 30 fragments per block; a total of 90 fragments in the propagator built under the shed. After germination, the seedlings were placed in polyethylene bags installed under the shade house, divided into 3 blocks each with 9 plots (lines). The area of the nursery: 35 m2 (7 m length, 5 m width).

Figure 2 shows the designed propagator.

Figure 2.Propagator

Steps for the realization of the PIF method

The steps are as follows: Selection of plant material; Extraction and grooming of offshoots; Blank trimming; Dehusking of offshoot; Drying of explants (draining); Rejuvenation and incision; Putting in a tray; Weaning and putting in a nursery.

The propagator is illustrated in Figure 3.

Figure 3.Decortication, establishment, weaning and acclimatization of shoots

Observed parameters

Observations were made on :

- The emergence rate of the seedlings by using the following formula: TL (in%) $= \frac{(\textbf{Number of sprouts emerged})}{(\textbf{Number of sprouts planted})}$ x 100;
- Number of seedlings emitted by counting;
- Height of weaned shoots using a tape measure;
- Diameter of corm of shoots using calipers:

- Weaning rate (TS in %)

$$= \frac{\textbf{Number of weaned shoots}}{\textbf{Number of shoots emitted}} X100;$$

- The number of plants per bulb;
- The incidence of Bunchy Top of banana in the nursery.

Statistical methods

The data for this study were collected, tabulated and the results were processed using SPSS 20.0 software. They were analyzed using the Analysis of Variance single criterion classification without sampling; the Snedecor F test and finally the Tukey test in order to identify the difference between treatments at the 0.05 probability threshold**.**

Results and discussion

Emergence rate

Figure 4 shows the emergence rate of the banana types after 15 days of the propagator.

The results in Figure 3 reveal that the emergence rate is 100% for all treatments, such a result denotes that the macroscopic selection of test shoots was rigorous. Such a result certified that the macroscopic selection was rigorous.

Number of seedlings emitted per corm and per type of plantain

The number of seedlings emitted per corm was recorded in Figure 5.

It was observed that a corm under this research condition emitted an average of 69 eyelets in the French type; 48 and 47 eyelets in the true and false horn types respectively.

Weaning rate by plantain type

The weaning rate was calculated and the results are recorded in Figure 6.

Weaning rates during this study were 60.9%; 67.2% and 82% for true horn, French and false horn types respectively.

Number of weaned shoots per corm and per plantain type

The number of weaned shoots per corm and per type of plantain is shown in Figure 7.

Per cormus, 44 offspring were weaned; 32 offspring and 30 offspring respectively for the French, true and false horn types. In view of these results, the French type gave more weaned rejects than the true and false horn types under Gbadolite conditions. The data are homogeneous because their coefficients of variation were less than 30%.

Shoot corm diameter at weaning in relation to plantain types

The corm diameter at weaning in relation to plantain types (in cm) is recorded in Figure 8.

The corm diameter at weaning was 1.6 cm for the French type; 1.5 cm for the true horn type and 1.7 cm for the false horn type under Gbadolite conditions with a coefficient of variation lower than 30%, which means that the results are homogeneous.

Height of shoots at weaning in relation to plantain types (in cm)

The results for height at weaning are shown in Figure 9.

The average height of seedlings at weaning was 17.7 cm, 19.6 cm and 19.9 cm for the French, false and true horn types, respectively. According to these results, at 30 days of rejection, the height of the shoots was homogeneous because the coefficient of variation was lower than 30%. The statistical analysis confirmed that the size of the rejects at weaning was significantly different from the French type, although the false horn was higher than the true horn

Observation of Bunchy Top of banana in nursery

Figure 10 shows the diseased subjects at Bunchy Top of plantain in nursery.

Figure 10.Bunchy Top of plantain in nursery.

During this study, the rate of Bunchy Top evolved around 6.25%. It appears that no matter how rigorous the macroscopic selection is, the symptoms of BBTV cannot be detected not only by this way but also microscopically, whose technique still constitutes a limiting factor to detect this virus in this part of the country.

Discussion

During this experiment, the rate of emergence was 100% for all treatments, a rate higher than 85% and 90.5% found in Kinshasa in the Democratic Republic of Congo[13] (Bangata et al., 2018). Such a result under Gbadolite conditions attested that the test discards were rigorously selected following the macroscopic technique by the researchers.

An average of 69 eyelets were counted in the French type; 48 and 47 eyelets in the true and false horn types respectively. This means that the French type has a greater power than the other types of plantains. Statistical analysis yielded the following decision: T3 T2 T1; this conclusion proved that in terms of rejection the types of the banana plants are not different during this study.

The weaning rates during this study were 60.9%; 67.2% and 82% for true horn, French and false horn types respectively. The other researchers in relation to the number of weaned seedlings after one month of incubation, noted that the highest number of weaned seedlings per fragment was observed in explants from two cooking banana and Bubi plantain with 7 and 6 seedlings respectively. In contrast, the lowest number of weaned seedlings was observed in explants from Dessert Gros Michel banana with 2 seedlings[13].

The weaned per corm, 44 replicates; 32 replicates and 30 replicates for French, true and false horn types respectively. The single-criteria analysis of variance for classification using the F Snedecor test confirmed that there is a significant difference in rejection power of plantain types using the PIF technique under the experimental conditions of Gbadolite. And Tukey's test gave the following decision: T3 T2T1; therefore, the plantain type with high rejection potential was the French type and then the True horn type which is not statistically different from false horn type.

As for the total number of weaned seedlings per explant, the highest number was observed in Saba and Cardaba cooking banana respectively with 35 and 34 seedlings, followed by Bubi plantain (cv. AAB) with 31 seedlings. While, the lowest total number of seedlings was observed in Dessert Gros Michel with 23 seedlings[13].

In view of the above, the number of offshoots obtained from this experiment using the same technique revealed that plantains under Gbadolite conditions yielded a higher

number of offshoots than bananas under Kinshasa experimental conditions.

Single-criterion analysis of variance with Snedecor's F test at the 5% probability level revealed a significant difference between treatments; Tukey's test concluded that the best treatment for high offspring was the French type using the FIP technique.

The number of leaves at weaning was about 3; with a corm size of 1.6 cm; 1.5 and 1.6 cm. The height varied from 17.7 cm to 19.6 cm. Leaf number is not influenced by technique as it characterizes the genetic background of the species[8 ; 17 ; 18].

Corm diameter at weaning was 1.6 cm for the French type; 1.5 cm for the true horn type and 1.7 cm for the false horn type under Gbadolite conditions; a diameter 0.05 cm greater than the stem diameter at the plug where the plant stem was firmly anchored in the middle plug and was not loose or bent. The leaves have a normal shape and color, and they are not bent, deformed, senescent or stained with any deficiency, disorder or disease[19].

The average height of seedlings at weaning was 17.7 cm; 19.6 cm and 19.9 cm for the French, false and true horn types, respectively. The seedlings weaned in this study were more than 8 cm high on average from the level of the plug to the junction of the two youngest leaves. The minimum height that was 5 cm and the maximum height of 12 cm. The plants have at least three healthy, dark green leaves on the upper half of the pseu- dostem and preferably five leaves at the time of delivery to the nursery. The stem of the plant is firm and straight, not soft or flexible[19].

During this study, it was observed that the incidence of bunchy top disease of plantain was on average 6.25%; which is a disease that affects the production of this crop. The rate of this disease in Gbadolite conditions ranged from 2.38 to 30% evaluated in Gabon where the disease is more prevalent in the focus of Ntoum, Bikélé and Essassa in Gabon[20].

Such a technique allows upstream to reduce the incidence of this disease at the field level because it reduces the yield of banana and plantain trees as it has been observed that this virus can reduce the production and area of banana trees up to 90-95%[21].

Conclusion

The present study aims to evaluate the influence of the techniques of planting from stem fragments (PIF) in relation to the types of cultivars of plantain (Musa sapientum L.) in Gbadolite in the Democratic Republic of Congo.

To test the main hypothesis that the PIF technique in relation to the types of banana plants would influence rejection. Specifically, to analyze whether plantain cultivar types would respond differently to the PIF technique and, furthermore, whether the French type would give more rejection by applying this technique than other plantain types.

The results suggest the following:

– Weaning rates in this study were 67.2%; 60.9% and 82% for the French, true and false horn types respectively.

– There were 44 rejections per cormus, 32 rejections and 30 rejections per cormus for the French, true and false horn types respectively. In view of these results, the French type gave a lot of weaned rejects than the true and false horn types in the Gbadolite conditions.

The French type gave a larger number of offsets than the other types. Thus, this type of plantain is best suited for use in producing large numbers of offshoots.

Based on these results, the following suggestions were made:

– Observe the influence of this technique on banana cultivars;

– Evaluate the performance of FIP and buckling under ex- and in-situ conditions.

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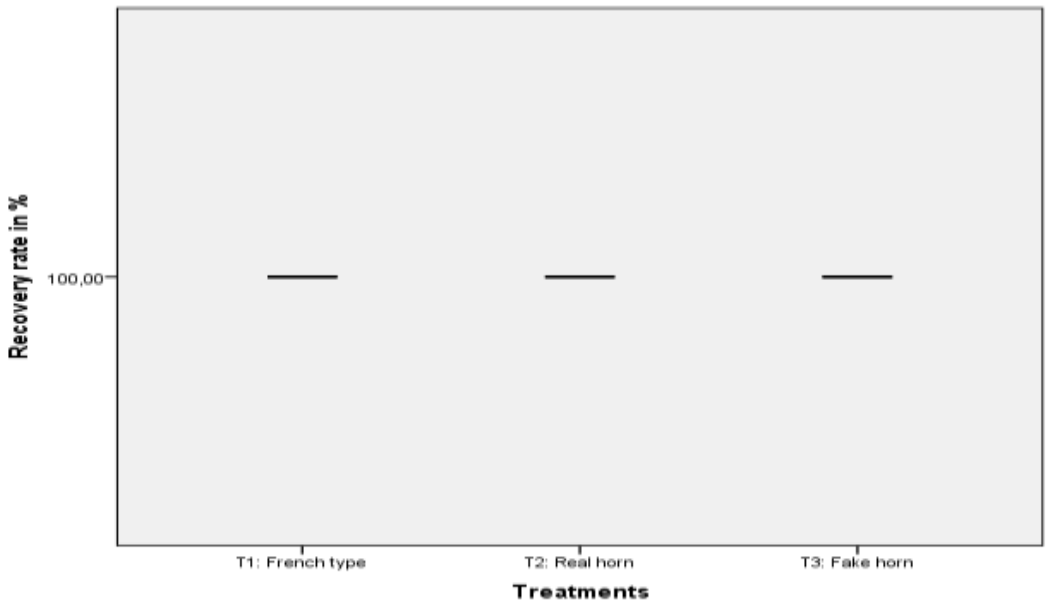

Figure 4.Explant emergence rate (%)

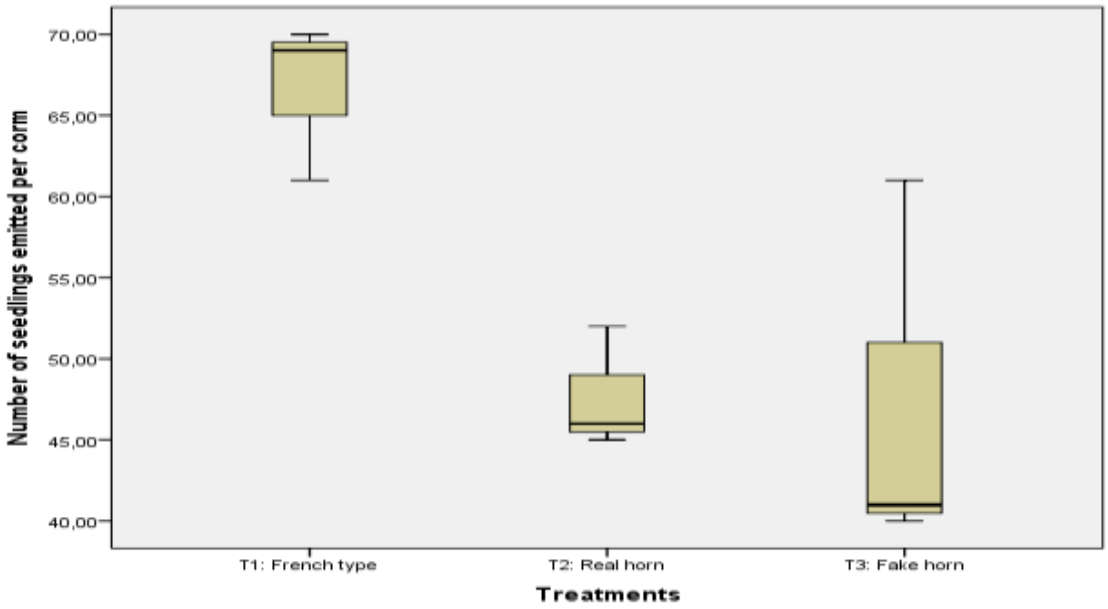

Figure 5. Number of seedlings emitted

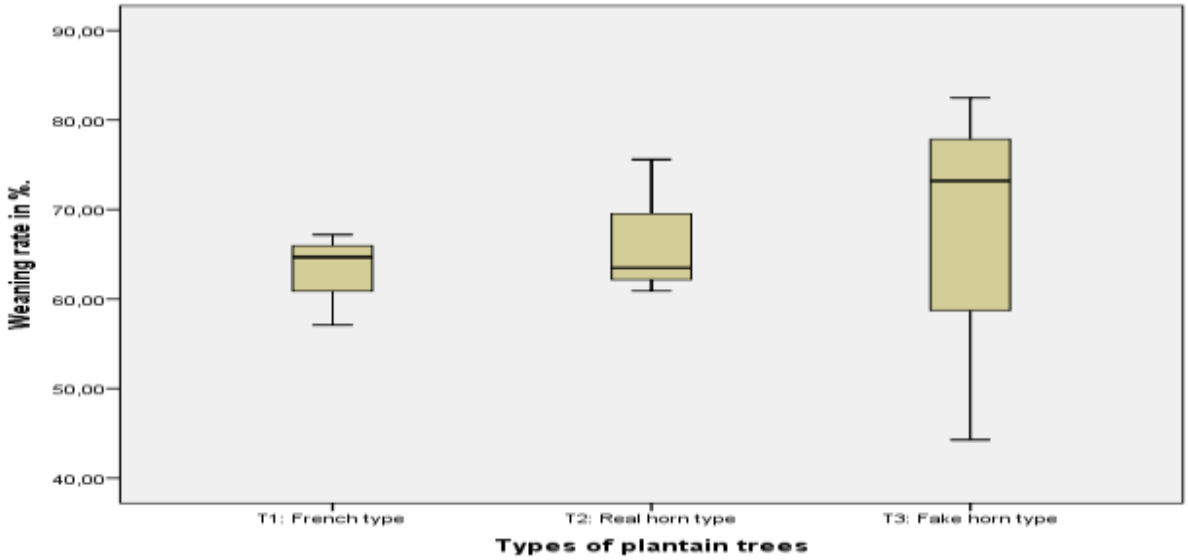

Figure 6. Weaning rates (%)

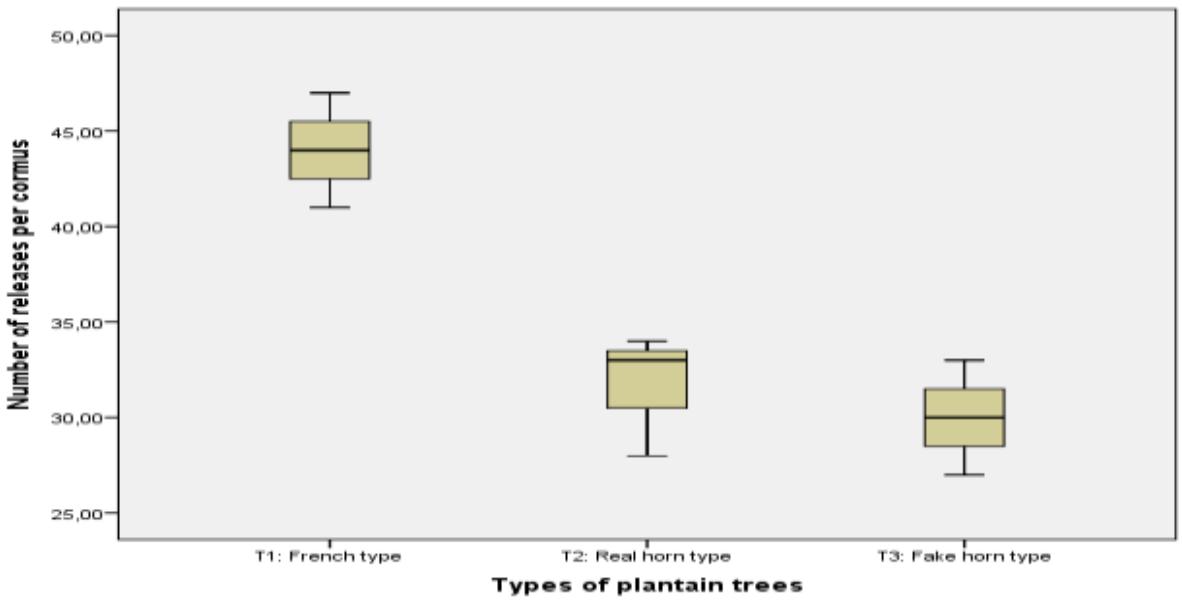

Figure 7. Number of discards weaned per cormus

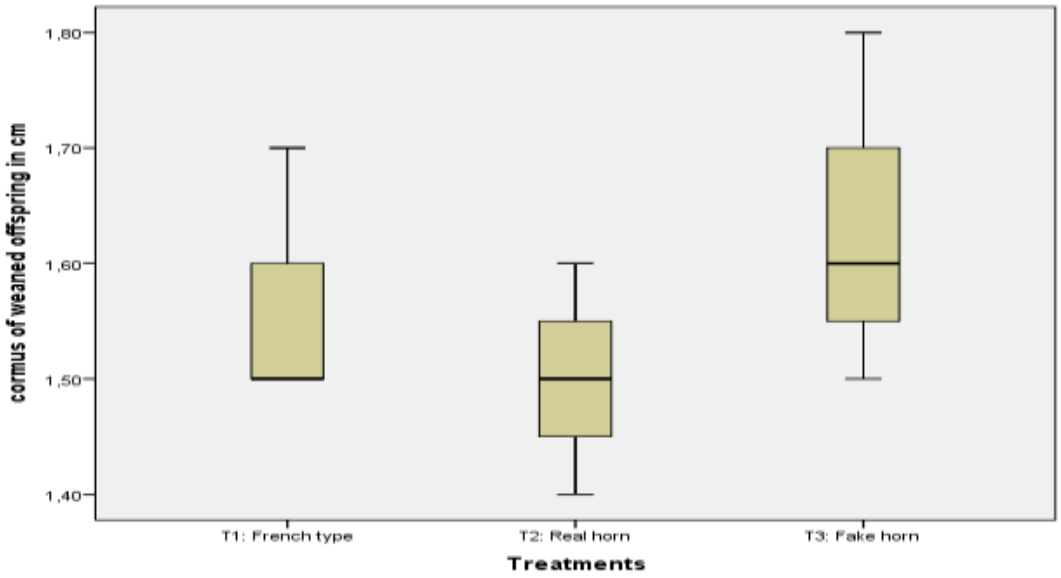

Figure 8. Cormus diameter at weaning in relation to plantain types (in cm).

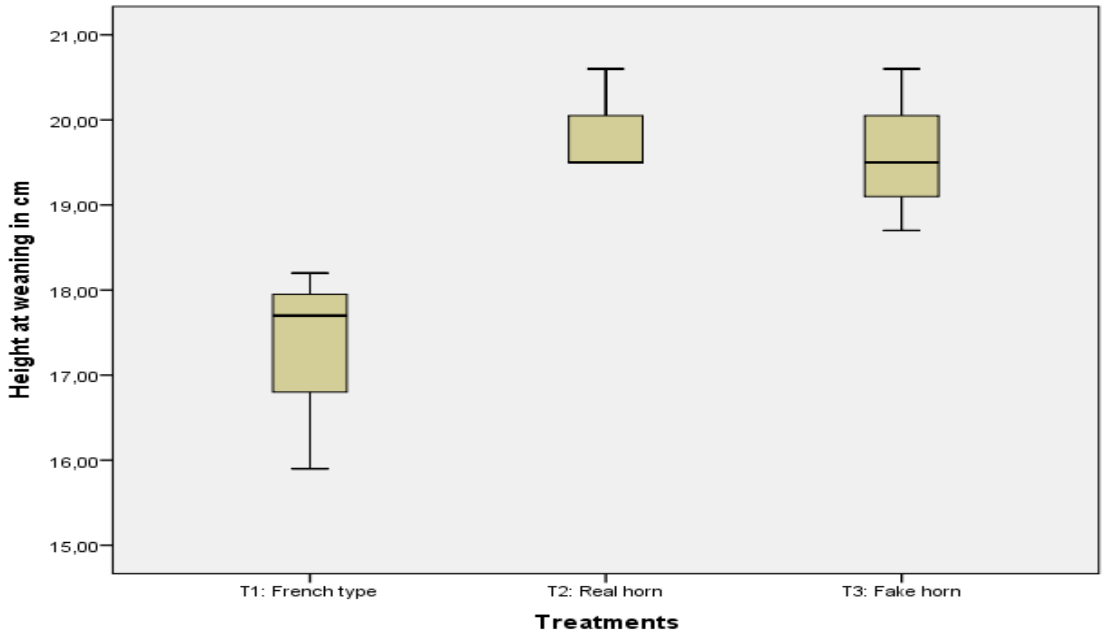

Figure 9. Offspring height in relation to plantain types (in cm).

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