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Collection behavior of the main banana and plantain cultivars grown in Maniema Province, DR Congo

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ABSTRACT

This work aims to study the collection field behavior of the most interesting banana and plantain cultivars for the populations surveyed in the province of Maniema. A 40 x 60 m collection field was installed in the experimental field of the Faculty of Agronomy of Kindu University, located on the Lwama 1 district. The spacings adopted were 3 x 3 m. The parameters collected for each cultivar were as follows: pseudostem length, neck diameter, number of leaves, leaf length and width, number of rejects, number of hands per diet, number of fingers / hand, finger circumference, finger length and diet weight. The results obtained showed that these cultivars have different vegetative and productive characteristics. The average values obtained were as follows: The length of the pseudostem varied from 120 cm to 351 cm; the neck diameter varies from 42.90 cm to 84 cm; the number of rejects varies from 2 (1.60) to (20.40); the number of hands varies from 1 cm to 8.50 cm; the number of finger / hand varies from 5.50 cm to 88.40 cm; the circumference / finger varies from 12 cm to 18.70 cm and finally the diet weight varies from 7 kg to 18.60 kg for all cultivars.

1. Introduction

The banana crop (Musa sp) plays a very important role in food security and income generation in smallholder households in the Democratic Republic of Congo. Banana is a multipurpose crop and is the fourth largest fruit crop in the world after citrus fruits and apples (Lassoudière, 1978).

World production of bananas is estimated at 102.687 million tonnes with 40 million for plantain. In East Africa, more specifically in Maniema, banana-annual crop combinations (bananas and cassava) are commonly practiced with the aim of increasing and differentiating the crops of small-scale farmers (Ntazongwa, et al., 2018). The low levels of yield in Africa can be explained by rudimentary cultivation techniques (non-respect of spacings between plants, poor selection of discards, non-phytosanitary monitoring that affect and hamper the production of this crop) (Van Damn, 2013).

The cultivated banana (banana and plantain) is a food source for millions of people around the world but also a source of income in the world in general and in Africa in particular (Tambwe et al., 2019). However, serious threats to the growth and development of banana are observed with a negative impact on yields, they are due to poor management of fertility and soil improvement, cultural techniques, germplasm choices and phytosanitary monitoring (Lassoudière, 2007, Dhed'a et al., 2011). The establishment of a banana crop implies compliance with standards in its conduct and management in soil fertility.

After studying the morphological diversity of banana and plantain in the province of Maniema, a collection field was set up with ten most interesting cultivars for comparison since they came from different sites. The main concern this research is trying to answer is: what is the collection behavior of the main banana and plantain cultivars grown in Maniema Province? The hypothesis underlying this study was formulated as follows: since each plant material has its own genetic heritage, we believe that the banana and plantain cultivars collected in the province of Maniema have different vegetative and productive characteristics and Behave differently.

2. Material and methods

2.1. Study site

The collection field behavior of different banana and plantain cultivars was studied in the Faculty of Agricultural Sciences, Kindu University, Lwama 1, Kindu, Maniema Province (DR Congo). The geographic coordinates of the experimental site are as follows: latitude S 04 ° 21'86.9 "; longitude E 02 ° 67'47.2 and 557 m above sea level.

2.2. Biological material

The plant material used in this study consisted of plants of banana and plantain cultivars collected from different crop sites during the morphological diversity study in the province of Maniema, RD. Congo (Tambwe et al., 2019).

2.3. Methods

2.3.1. Experimental setup and observations

A 40 x 60 m collection field was installed in the experimental field of the Phytotechia Department of Kindu University, located in Lwama 1. Overall, 10 cultivars were selected and each cultivar was repeated. Ten times to follow the behavior and continue the description of these

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cultivars suspected new and appreciated by farmers in the area. The spacings adopted were 3 x 3 m. Maintenance care consisted of weeding and leaf removal.

Observations focused on the following parameters: Pseudo-trunk length in cm, collar diameter in cm, number of leaves, leaf length and width in cm; the number of rejections, the number of hands per regimen, the number of fingers / hand, the finger circumference in cm, the finger length in cm and the kilogram weight in kilograms.

2.3.2. Statistical analyzes

For each variable selected and collected, we started with the verification of the normality of the residues with the Shapiro test. The null hypothesis of this test is that the data follow a normal distribution. A significant p-value therefore implies that the data is not normal. If, on the other hand, normality was still not achieved, we finally opted for Kruskal-Wallis tests. Statistical analyzes were performed using software R version 3.1.1 (Cornillon et al., 2008).

3. Presentation of the results

Table 1 presents the average values of the parameters observed in the experimental field of collection for the ten most popular cultivars in the study area.

The analysis of this table shows that the Kyankola cultivar has the highest pseudostem length of all other cultivars, followed by Camera, then Kitika Nguvu, Kisamunya, Mwasi Zoba, Otangala, Mbudi I, Mbundi II. , Kambelekete and finally Mumbote. The comparison of the ten cultivars by the Shapiro test indicated a very significant difference to a normal distribution of the data (Sh = 0.9505, p = 0.001). Since normality was not achieved, we opted for the non-parametric Kruskal-Wallis test, which showed a very significant effect of the pseudostem length factor of different cultivars (W = 73.817, Ddl = 9, p <0, 01).

As for the neck diameter, the Kyankola cultivar always comes first, followed by Kitika Nguvu, Mbundi II, Mwasi Zoba, Mumbai, Camera, Otangala, Mundi I, Kisamunya, Mumbai and Kambelekete in the last position. For neck diameter (Appendix 2, Table 2.1), the comparison between the ten cultivars by the Shapiro test indicated a non-significant difference to a normal distribution of the data (Sh = 0.9837, p = 0.2569), therefore the residues follow a normal distribution (normal distribution). One-way analysis of ANOVA variance showed a very highly significant effect of pseudo-trunk neck diameter factor (F = 23.99, p <0.0000).

Regarding the number of leaves, the Otangala cultivar is the first, followed by Kambelekete, Mwasi Zoba, Kitika Nguvu, Mbudi II, Mbudi I, Kyankola, Kisamunya, Mumbote and finally Camera. Regarding the number of leaves, the comparison between the ten cultivars by the Shapiro test indicated a significant difference to a normal distribution of the data (Sh = 0.9373, p = 0.000), so the residues do not follow a normal distribution (normal distribution). As normalcy was not achieved, we opted for the nonparametric Kruskal_Wallis test, which showed a very significant effect between leaf numbers of different cultivars (W = 29.631, Ddl = 9, p <0.001).

Regarding leaf length, the Kyankola cultivar still confirms the first place, followed by Camera, Mbudi II, Mombote, Kisamunya, Mwasi zoba, Kambelekete, Kitika-Nguvu, Otangala and Mbudi I. Regarding leaf length, comparison between the ten cultivars by the Shapiro test indicated a significant difference to a normal distribution of the data (Sh = 0.89824, p <0.001), so the residues do not follow a normal distribution (normal distribution). As normalcy was not achieved, we opted for the non-parametric Kruskal_Wallis test which showed a very significant effect between leaf numbers of different cultivars (W = 45.018, Ddl = 9, p <0.001).

As for the width of the leaves, the cultivar Mbudi I occupies the first place, followed by Camera, Mbudi II, Kyankola, Kisamunya, Mwasi Zoba, Otangala, Kambelekete, Mombote, Kitika Nguvu. Regarding leaf width, the comparison between the ten cultivars by the Shapiro test indicated a significant difference to a normal distribution of the data (Sh = 0.83221, p <0.001), so the residues do not follow a normal distribution. Normality not being achieved, we opted for the non-parametric Kruskal-Wallis test, which showed a very significant effect between leaf numbers of different cultivars (W = 37.837, Ddl = 9, p <0.001).

Regarding the number of discards, the Mbudi II cultivar is in the lead, followed by Kisamunya, Kitika Nguvu, Kyankola, Camera, Mwasi Zoba, Otangala, Mbudi I, Kambelekete and finally Mumbote. Regarding the number of rejects, the comparison between the ten cultivars by the Shapiro test indicated a significant difference to a normal distribution of the data (Sh = 0.97034, p = 0.0234), so the residues do not follow a normal distribution. As normality was not achieved, we opted for the non-parametric Kruskal-Wallis test, which showed a very significant effect between the rejection numbers of different cultivars (W = 68.451, Ddl = 9, p <= 0.001). Therefore, there is a significant difference between the average numbers of discards per cultivar.

Regarding the number of hands, the cultivar Kitika Nguvu is in the lead, followed by Mumbote, then Kisamunya, Kyankola, Camera, Kambelekete, Mwasi Zoba, Otangala, Mbudi II and finally Mbudi I. Regarding the number of hands, the comparison between the ten cultivars by the Shapiro test indicated a significant difference to a normal distribution of the data (Sh = 0.972, p = 0.03153), so the residues do not follow a normal distribution. As normalcy was not achieved, we opted for the nonparametric Kruskal-Wallis test, which showed a very significant effect between the number of rejects of different cultivars (W = 64.046, Ddl = 9, p <0.001).

In addition, the number of finger / hand, the cultivar Kyankola is in the lead, followed by Otangala, Mumbush, Kitika Nguvu, Kisamunya, Kambelekete, Mbudi II, Mwasi Zoba, Camera and Mbudi I in last position. Regarding the number of fingers per hand, the comparison between the ten cultivars by the Shapiro test indicated a significant difference to a normal distribution of the data (Sh = 0.94478, p = 0.0003818). Normality not being achieved, we opted for the nonparametric Kruskal_Wallis test which showed a very significant effect between the finger / hand numbers of different cultivars (W = 74; 126, Ddl = 9, p <0.001).

As for the circumference of finger / hand, It is the Mbudi II cultivar which comes first, followed by Mbudi I, Otangala, Kambekete, Kitika-Nguvu, Mumbai, Kisamunyi, Mwasi Zoba, Kyankola and Camera. Regarding the finger / hand circumference, the comparison between the ten cultivars by the Shapiro test indicated a significant difference to a normal distribution of the data (Sh = 0.93808, p = 0.0001). So, there is a significant difference between the finger-per-hand circumference of these ten cultivars. Normality not being achieved, we opted for the non-parametric Kruskal-Wallis test which showed a very significant effect between finger / hand numbers of different cultivars (W = 62.224, Ddl = 9, p <0.001).

Table 1.Mean values of observed parameters in fields.

Cultivars / Paramètres	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
Longueur pseudo-tronc (cm)	226,80±25,98	245,60±49,48	303,00±17,03	351,00±6,63	242,30±16,79	262,88±54,00	295,40±11,62	291,10±10,80	120,00±5,54	267,90±22,21
Diamètre au collet (cm)	42,90±7,23	49,50±9,40	51,70±4,45	84,00±5,73	70,30±6,93	50,00±10,91	71,20±6,23	47,60±5,93	51,80±7,87	56,00±14,91
Nombre de feuille	3,14±0,90	2,00±0,00	1,33±0,58	1,80±0,63	2,00±0,82	4,33±1,37	1,50±0,71	1,75±0,50	1,50±0,71	2,50±0,71
Longueur de feuille (cm)	18,38±8,01	13,50±16,26	213,33±11,55	247,70±23,49	188,71±53,56	59,04±84,09	31,00±1,41	148,75±5,97	150,00±0,00	78,50±0,71
Largeur de feuille (cm)	56,57±11,06	134,50±135,06	85,00±6,24	73,50±6,65	78,42±7,35	58,83±17,86	16,00±2,83	73,50±8,50	39,00±0,00	48,00±4,24
Nombre de rejets	6,00±1,49	6,30±2,67	7,10±1,20	7,30±0,82	20,40±5,62	6,90±3,70	9,10±3,07	13,70±1,70	1,60±0,52	7,00±1,15
Nombre de main	6,40±1,84	1,00±0,00	6,50±1,58	6,70±0,82	2,00±0,00	5,70±4,42	8,50±1,27	7,40±1,35	7,80±1,03	6,40±0,97
Nombre de doigt /main	14,60±5,42	5,50±2,72	8,70±2,63	88,40±5,76	12,60±3,98	20,90±7,20	15,60±1,07	15,00±1,76	19,40±1,96	12,10±1,37
Circonférence/doigt (cm)	18,10±2,23	19,00±3,89	12,00±1,15	12,40±1,26	21,30±3,13	18,70±3,59	15,50±2,37	12,90±1,37	13,80±1,93	12,70±1,16
Longueur de doigt (cm)	22,40±2,99	27,60±7,15	14,20±1,48	12,10±1,29	43,00±5,37	23, 23,20±4,54	16,20±2,20	7,10±2,33	14,70±2,06	14,70±1,89
Poids de régime (Kg)	7,50±1,78	8,60±2,12	7,60±1,35	12,10±1,29	12,30±3,30	10,40±2,95	18,40±1,78	7,40±1,17	18,60±3,63	17,70±2,31

Légende : C1 Kambelekete ; C2 Mbudi I; C3, Camera ; C4 : Kyankola ; C5 Mbudi II ; C6 , Otangala ; C7 : Kitika Nguvu ; C8 , Kisamunya ; C9 , Mumbote ; C10, Mwasizo

In terms of finger / hand length, Mbudi II is the dominant cultivar, followed by Mbudi I, Otangala, Kambelekete, Kitika Nguvu, Mumbote, Mwasi Zoba, Camera, Kyankola and as a last resort Kisamunyi. Regarding finger / hand length, the comparison between the ten cultivars by the Shapiro test indicated a significant difference to a normal distribution of the data (Sh = 0.93198, p <0.001). Normality not being achieved, we opted for the non-parametric Kruskal-Wallis test, which showed a very significant effect between the finger / hand lengths of different cultivars (W = 84, 606, Ddl = 9; 0.001).

Finally, in terms of diet weight, the cultivar of Mumbote has a high weight relative to other cultivars, followed by Kitika Nguvu, Mwasi Zoba, Mbudi II, Kyankola, Otangala, Mbudi I, Camera, Kambelekete and Kisamunyi. Regarding diet weights, the comparison of the ten cultivars with the Shapiro test indicated a significant difference to a normal distribution of the data (Sh = 0.95362, p = 0.001447). Normality not being achieved, we opted for the non-parametric Kruskal-Wallis test which showed a very significant effect between the diet weights of different cultivars (W = 75.497, Ddl = 9, p <0.001).

4. Discussion of the results

The results relating to the behavior of bananas and plantains installed in the edapho-climatic conditions of Kindu were as follows: pseudo-trunk length varies from 120.00 ± 5.54 to 351.00 ± 6.63 cm; when at the neck diameter 42, 90 ± 7.23 to 84.00 ± 5.73 cm. Regarding the number of rejects varies from 1.60 ± 0.52 to 20.40 ± 5.62 cm; regarding the number of hands, the values vary between 1.00 ± 0.00 to 8.50 ± 1.27 cm. In addition, the number of finger / hand varies from 5.50 ± 2.72 to 88.40 ± 5.76 cm; As for the finger / hand circumference ranges from 12.00 ± 1.15 to 18.70 ± 3.59 cm. Finally, with regard to the weight of diet, it varies from 7,40 ± 1,17 to 18.60 ± 3.63 kg. The results do not differ from the average data collected on the banana plant in the Walungu group (Ntazongwa et al., 2018). Note that this growth of banana and plantain is rhythmic, as rain remains a key to water satisfaction as reaffirmed the work on growing banana in Congo Brazza (Anno, 1981) and South Kivu (Ntazongwa et al. , 2018).

The results of banana circumference in the experimental site ranged from 12.00 ± 1.15 to 18.70 ± 3.59 cm after 164 days, which is similar to the data collected by (Turquin, 1998; Lassoudière , 2007; Ntazongwa et al., 2018), where their work summarizes that circumference in their study conditions is around 78.5 cm in adulthood.

Banana and plantain are found in all these ecosystems of Maniema. However, for several decades, yields have been declining and although this decline is remarkable, the factors involved are still unknown. Decreased soil fertility in these old production systems and minimal management have been suggested.

In Africa, bananas and plantains are grown mainly by small farmers, who do not have easy access to chemical fertilizers. The potential of traditional organic fertilizers such as compost, manure and mulch crop residues must therefore be better exploited. Banana and plantain are plants that immobilize larger amounts of soil minerals (Ntazongwa et al., 2018).

In field conditions, there is reason to believe that the level of soil fertility is at the root of the very remarkable decrease in the incidence of the disease on plants. This means that even bananas and plantains, which are regularly susceptible to house conditions and fallows, are less infected and therefore have better growth (Ntazongwa et al., 2018).

5. Conclusion

The objective of this work is to make an experimental field evaluation of the banana and plantain cultivars most interesting for the populations surveyed in the province of Maniema. The results obtained showed that these cultivars have different vegetative and productive characteristics. The length of the pseudostem varied from 120 cm to 351 cm; the neck diameter varies from 42.90 cm to 84 cm; the number of rejects varies from 1.60 cm to 20.40 cm; the number of hands varies from 1cm to 8.50 cm; the number of finger / hand varies from 5.50 cm to 88.40 cm; the circumference / finger varies from 12 cm to 18.70 cm and finally the weight varies from 7 kg to 18.60 kg as indicated by the parameters observed in the collection. These cultivars have different characteristics as indicated in Table 1 relative to the parameters observed in collection. In addition, all banana and plantain cultivars, as compared to previous knowledge on plantain bananas in the region, have been described. What enriches the biodiversity knowledge of this crop in the Maniema Province and thus confirms the hypothesis on the existence of banana and plantain cultivars collected in the province of Maniema have vegetative and productive characteristics and behave differently.

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