"Characterization of Musa sp. Fruits and Plantain Banana Ripening Stages According to Their Physicochemical Attributes"

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Abstract

This study aimed at understanding the contribution of the fruit physicochemical parameters to Musa sp. diversity and plantain ripening stages. A discriminant analysis was first performed on a collection of 35 Musa sp. cultivars, organized in six groups based on the consumption mode (dessert or cooking banana) and the genomic constitution. A principal component analysis reinforced by a logistic regression on plantain cultivars was proposed as an analytical approach to describe the plantain ripening stages. The results of the discriminant analysis showed that edible fraction, peel pH, pulp water content, and pulp total phenolics were among the most contributing attributes for the discrimination of the cultivar groups. With mean values ranging from 65.4 to 247.3 mg of gallic acid equivalents/100 g of fresh weight, the pulp total phenolics strongly differed between interspecific and monospecific cultivars within dessert and nonplantain cooking bananas. The results of the logistic regress...

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Characterization of *Musa* sp. Fruits and Plantain Banana Ripening Stages According to Their Physicochemical Attributes

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ABSTRACT: This study aimed at understanding the contribution of the fruit physicochemical parameters to *Musa* sp. diversity and plantain ripening stages. A discriminant analysis was first performed on a collection of 35 *Musa* sp. cultivars, organized in six groups based on the consumption mode (dessert or cooking banana) and the genomic constitution. A principal component analysis reinforced by a logistic regression on plantain cultivars was proposed as an analytical approach to describe the plantain ripening stages. The results of the discriminant analysis showed that edible fraction, peel pH, pulp water content, and pulp total phenolics were among the most contributing attributes for the discrimination of the cultivar groups. With mean values ranging from 65.4 to 247.3 mg of gallic acid equivalents/100 g of fresh weight, the pulp total phenolics strongly differed between interspecific and monospecific cultivars within dessert and nonplantain cooking bananas. The results of the logistic regression revealed that the best models according to fitting parameters involved more than one physicochemical attribute. Interestingly, pulp and peel total phenolic contents contributed in the building up of these models.

KEYWORDS: Musa sp. fruits, physicochemical analysis, total phenolic compounds, ripening stage, discriminant analysis, principal component analysis, logistic regression

INTRODUCTION

With a world production of more than 138 million tons in 2010, bananas (Musa sp. fruits) are the seventh most important food crop after maize, rice, wheat, potato, soybean, and cassava.¹ Although Asia is the continent of origin of both wild and cultivated Musa sp., this crop is now also widely cultivated in Latin America, Caribbean countries, and Africa, where their fruits contribute to food security and socio-economical life. Studies have shown that bananas are good sources of starch, fibers, minerals (potassium, magnesium, phosphorus, manganese), and vitamin B₆ for consumers.² Furthermore, bananas are a source of natural dietary antioxidants such as carotenoids and phenolic compounds, which exhibit health-promoting effects including antioxidant, anti-inflammatory, antibacterial, and anticancer activities.^{3,4} Our recent study revealed that bananas are good sources of phenolic compounds, hydroxycinnamic acids, particularly ferulic acid-hexoside, and flavonol glycosides e.g. rutin dominating in the plantain pulp and peels, respectively.⁵ Information about the nutrient composition of bananas is of major importance for breeders and programs of varietal dissemination.

Edible *Musa* sp. are characterized by a large diversity, which constitutes one of the most interesting property for breeders.

Several field collections exhibiting Musa sp. diversity are hosted in Latin America, India, Asia, and Africa countries where they are managed for breeding.⁶ Musa sp. genotypes are generally classified according to the consumption mode of the fruits (dessert or cooking bananas) and the constitution of their genome.^{7,8} The wild diploid bananas are characterized by the presence of seeds in their pulps and include two main species Musa acuminata Colla (AA) and Musa balbisiana Colla (BB), which contributed to the major groups of edible bananas. Intraand interspecific hybridizations between these wild species in nature gave rise to many seedless cultivars whose reproduction occurs by vegetative multiplication (rationing or suckering). These cultivars are diploids or triploids with different genomic constitutions composed of genome A or genomes A and B. According to molecular and cytological studies, most of the edible cultivars have the genomic constitutions AA, AB, AAA, AAB, or ABB.^{9,10} Their peels are mostly green at harvest.

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groups based on the consumption mode	genomic constitution ^b	subgroup	name of the accessions	peel color at harvest	groups based on the consumption mode and the genomic constitution
dessert	AAA	Ibota	Yangambi km5	green	D-A
	AAA	Ibota	Khom Bao	green	
	AAA	Red	Figue Rose Naine	red	
	AB	Ney Poovan	Figue Pome Ekona	green	D-AB
	AB	Ney Poovan	Safet Velchi	green	
	ABB	ABB ind.	Rana	green	
nonplantain cooking	AA	AAcv ind.	Kekiau	green	NPC-A
	AA	AAcv ind.	Tomolo	green	
	AAA	Lujugira	Mujuba	green	
	AAB	Laknao	Laknao	green	NPC-AB
	AAB	Maia Maoli	Iho-U-Maohi	green	
	AAB	ABB ind.	Kupulik	green	
	ABB	Kalapua	Dwarf Kalapua	green	
	ABB	Pelipita	Pelipita.	green	
plantain cooking	AAB	Plantain	Mbeta 1	green	PC-French ^c
1 0	AAB		Red Yade	green	
	AAB		French Rouge 18	green	
	AAB		Ntie	green	
	AAB		Rouge de Loum	green	
	AAB		Banane Tigrée	green with black spots	
	AAB		Kar Ngou	green with chestnut pigments	
	AAB		French Sombre	green	
	AAB		Meki	green	
	AAB		Kelong Mekintu	green	
	AAB	plantain	Mbouroukou no. 1	green yellowish	PC-Horn ^c
	AAB		3/4 Nain	green	
	AAB		Batard	green	
	AAB		76-17	green	
	AAB		Niangafelo	red silver,	
	AAB		Essang	green with chestnut pigments	
	AAB		Soya	green with chestnut pigments	
	AAB		Moto Ebanga	chimeric green white	
	AAB		Ihitisim	green	
new hybrids		secondary triploid hybrids derived	C 292	green	unknown
		from plantain (AAA/AAB	F 568	green	

Table 1. Description of Musa sp. Fruits Collected at Harvest^a

^aAbbreviations: cv, cultivar; ind, undetermined; D, dessert; NPC, nonplantain cooking; PC, plantain cooking. ^bA, B: genomic constitution of *Musa* accuminata and *Musa* balbisiana respectively. ^cFrench, Horn: agro-morphological character within plantain cooking indicating respectively the presence or the absence of the male bud at harvest.

Central Africa is considered as a secondary center of plantain (a type of cooking banana) diversity harboring a wide range of unique varieties.^{11,12} In general, the presence or absence of the male bud at harvest is used to distinguish the two main types of plantain, namely, the French and the Horn plantains, respectively. There is also a wide diversity in fruit peel colors. Somatic mutations are likely to be responsible for the great morphological diversity observed in plantains.¹³ Moreover, the breeders undertake crossings between *Musa* varieties including wild species and cultivars. This leads to the creation of hybrids with improved disease resistance such as CRBP 14, CRBP 39, FHIA 17, and FHIA 21, which contribute to the diversity observed in this group.¹⁴

Due to the large diversity of bananas, there is still a lack of information on the physicochemical characteristics of fruits of numerous varieties. Most of the studies focused on the export dessert banana "Grand Nain" (AAA). Investigations on plantain are often limited to their pulps. For instance, Gibert et al.¹⁵ investigated the difference between dessert and cooking bananas based on some physicochemical characteristics of the

pulp and found that dry matter, edible fraction, pH, total ash, and total sugar can help to differentiate dessert, nonplantain cooking, and plantain cooking bananas. However, more information may emerge if the secondary metabolites as well as the overall physicochemical attributes of the fruit pulp and peel are also taken into account.

Edible Musa sp. are also characterized by the ripening process occurring during the storage. During ripening, the fruits undergo physicochemical changes associated with organoleptic and nutritional modifications. These changes have many implications on their uses in food processing. For instance, the quality of plantain banana chips and the functional properties of dessert banana flour vary according to the ripening stage of the raw material.¹⁶⁻¹⁸ In field collections, postharvest characterization of the ripening stages are assessed on dessert and cooking bananas.¹⁹ However, the identification of the fruit ripening stages is currently based on a subjective color scale, which is designated for dessert banana with green peels at harvest.²⁰ With regard to the large diversity of peel color among plantain cultivars, there is a need to predict the ripening stages of the fruits using quantitative attributes. A study on some physicochemical characteristics of plantain pulp and peel during ripening reported changes in edible fraction, pH, dry matter, and pulp soluble solids.21 To our best knowledge, no attempt to predict the ripening stage from these postharvest physicochemical characteristics has been reported.

This study proposed multivariate analytical approaches to describe how some postharvest physicochemical characteristics can be used (i) to discriminate groups within the diverse *varieties* of *Musa* sp. and (ii) to predict the ripening stages in plantains.

MATERIALS AND METHODS

Plant Material. The starting plant material consisted of 33 Musa genotypes from the germplasm collection of the African Research Centre on banana and plantain (CARBAP) in Njombe in the littoral region of Cameroon at 80 m above the sea level (Table 1).²² This working collection was organized in six cultivar groups based on their consumption mode, genomic constitution and morphological characters. Each of the three consumption groups, which are dessert, nonplantain cooking, and plantain cooking bananas, were divided in two subgroups. For dessert and nonplantain cooking bananas, monospecific varieties were separated from interspecific varieties. The first group contained only the A genome (A group) whereas the other one was made of varieties containing both the A and B genomes (AB group). For the plantains, the two main phenotypic classes (French and Horn) were separated. In addition, two newly created plantain-like hybrids resistant to the black Sigatoka disease were also part of the study and constituted a separated group. Bunches were harvested at CARBAP in 2010 at physiological maturity according to the protocol described by Tchango, Achard and Ngalani.²³ For each genotype, two to three bunches from different plants were used.

At least 15 fruits were collected from the middle hands of each bunch and allowed to ripe at room temperature in cardboard containers. Dessert and plantain banana ripening stages have been defined on the basis of changes in peel colors according to the scale described by Soltani, Alimardani, and Omid.²⁰ The four ripening stages 1, 3, 5, and 7 assessed correspond to peel color being all green, greener than yellow, yellow with green ends, and yellow with brown speckles, respectively. For each ripening stage, 3 fruits were removed from the cardboard and weighted. Each fruit was cut on the length and across the width into four quarters. Diagonally opposite quarters were put together to form two groups. For each group, samples from the three fruits were pooled. The pulps and peels of one group were separately freeze-dried, ground, and then vacuum sealed in polypropylene plastic bags. The other group was used for the determination of color, edible fraction, peel thickness, total soluble solids, pH, and total ash content. The freeze-dried samples were transported to the laboratory (Louvain-La-Neuve, Belgium) and kept at -20 °C.

Chemicals. Gallic acid and Folin-Ciocalteu reagent (2 N) were purchased from Sigma (St Louis, MO). Pure acetone, glacial acetic acid, and sodium carbonate (purity \geq 99.5) were respectively obtained from Prolabo (Fontenay-sous-bois, France), Fisher Scientific (Loughborough, U.K.), and Merck (Darmstadt, Germany).

Physicochemical Analyses. Banana Peel and Pulp Color. The color of peel and pulp was assessed at different ripening stages by a hand-held color reader (CR-14, Konica Minolta, Japan) displaying the CIE Yxy chromaticity coordinates. The recorded values were then transformed into C (chroma) and L (lightness) color indexes.²⁴

Edible Fraction and Peel Thickness. Two quarters of each fruit were separately weighted, the peel was then separated from the pulp and weighted. Edible fraction (%) was calculated by dividing the pulp weight by the pulp and peel weight. Peel thickness was measured using a caliper, and the result was expressed in millimeters.

Total Soluble Solids and pH. Total soluble solids and pH were determined according to the methods described in the International Network of the Improvement of Banana and Plantain technical guidelines.¹⁹ For each part of the fruit, a mixture of the sample in distilled water (1:3, w: w) was vigorously blended for 2 min. The mixture was filtered using a Whatman no. I paper and the refraction index was read using a visual hand-held refractometer. The total soluble solids were expressed in degrees Brix (°Bx). The pH was measured with a benchtop pH meter (Knick, Berlin, Germany).

2.3.4. Water and Total Ash Contents. The fresh samples of pulp and peel were separately analyzed for their water and ash contents according to the norms of AFNOR.²⁵ Water content was determined by oven drying for 24 h at 105 °C. The content of total ash composed of free minerals and mineral salts was determined by calcinating the dried samples at 550 °C during 24 h. The results were expressed in percentage of the fresh sample.

Total Phenolic Content. For each freeze-dried banana peel and pulp sample, 0.5 g were extracted with 10 mL of acetone/water/acetic acid (50:49:1). The mixture was vortexed for 1 min. and the extraction was carried out in a water bath under agitation at 40 °C for 1 h. The extract was centrifuged at 5000g for 20 min at 4 °C. The colorimetric method²⁶ for total phenolic content determination was then used as a measure of the reducing capacity of the sample.²⁷ For the calibration curve, 5 concentrations were prepared from a stock solution of gallic acid. The results were expressed in milligrams gallic acid equivalents (GAE)/100 g of fresh weight (FW).

Statistical Analysis. The statistical analysis of the data was performed by the JMP9.0 statistical discovery software from SAS and SAS entreprise guide 4.3.

Discriminant Analysis. A linear discriminant analysis²⁸ was performed to (i) compare the physicochemical profile of the six cultivar groups, and to (ii) assign each new hybrid fruit to one of the groups. To compare cultivar groups, the software displayed the scatterplot of the *Musa* sp. fruit scores and the loading plot of the physicochemical attributes. The loading plot reflected the relative contribution of physicochemical attributes to the separation of the groups. In order to identify to which cultivar group a new hybrid fruit sample is closest, classification functions were created for each group in the form

$$F = b_1 x_1 + b_2 x_2 + \dots + b_n x_n + c \tag{1}$$

Each of the six classification functions were evaluated with the physicochemical attributes (x) of the hybrid fruit sample. This later was assigned to the group whose classification function yielded the highest value.

Logistic Regression. In order to predict the ripening stage of plantain cultivars according to physicochemical attributes, an ordinal logistic regression was performed. The ripening stage was considered as an ordinal response with 4 modalities. For each ripening stage, the software gave the cumulative logit(j), which is the logarithmic function of the ratio between the cumulative probability $P(y \le j)$ that a plantain

sample "y" is at a level less or equal to a given ripening stage "j" with j = 1, 3, 5, or 7 and the probability that it is not $(1 - P(y \le j))$. Its formula as adapted from Gillet, Brosteaux, and Palm²⁹ is written as follows:

$$Logit(j) = \ln \frac{P(y \le j)}{1 - P(y \le j)} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p$$
(2)

In eq 2, β_0 is the constant, each of the $\beta_{(1\rightarrow p)}$ values stands for the coefficients related to each X physicochemical attribute. The model gives the coefficients for the first three ripening stages, the last one being used as the reference in the statistical procedure. The models were evaluated by the R^2 and the corrected Akaike information criterion (AICc), which measures the fit of the model.³⁰ Twelve plantain genotypes with a green peel color at stage 1 were used to build the models. Only models explaining at least 70% of the variability are presented. Three plantain genotypes (two with three biological replicates and one with two biological replicates) with green peel with chestnut pigments at stage 1 were used to investigate the abilities of the models to predict the ripening stages. To predict the ripening stage of a plantain sample y, the probability P(y = j) for this sample to be at a ripening stage j is estimated for each ripening stage and the sample is considered to be at the ripening stage that has the highest probability. For that, the cumulative probability $P(y \le j)$ formula is first deduced from eq 2 as follows:

$$P(y \le j) = \frac{e^{\log(t(j))}}{1 + e^{\log(t(j))}}$$
(3)

Cumulative probabilities are then calculated for ripening stages 1, 3, and 5 and probabilities P(y = j) are deduced as follows:

$$P(y = 1) = P(y \le 1)$$
 (4)

$$P(y = 3) = P(y \le 3) - P(y \le 1)$$
(5)

$$P(y = 5) = P(y \le 5) - P(y \le 3)$$
(6)

$$P(y = 7) = 1 - P(y \le 5)$$
(7)

RESULTS AND DISCUSSION

Physicochemical Composition of Cultivar Groups at Harvest. General Description. Tables 2 and 3 present the results of the physicochemical composition of the seven groups of Musa sp. fruits. At harvest, the fruits were at the ripening stage 1.

Most of the physicochemical attributes studied varied according to the cultivar groups. Significant differences were observed for pulp color indexes L and C (chroma and lightness), edible fraction, peel thickness, pulp water content, pulp total soluble solids, pulp pH, and pulp total phenolic compounds. As regard the comparison between pulp and peel, the physicochemical attribute values were different except for total soluble solids and pH. The observations about the L index being lower in peel and the water content being higher in peel were also reported in the literature for dessert bananas.^{31,32} The data showing that the total phenolic compounds were (1.5 to 2 times) higher in peel than in pulp also matched with a report published on total phenolic compounds in Malaysian bananas.³³

Among the dessert bananas, the cultivar Yangambi kmS presented the highest content of pulp total phenolic compounds (306.4 mg GAE/100 g FW). The contents obtained for A dessert banana pulps were higher than the contents reported for the dessert banana Pisang Mas (35.9–72.2 mg GAE/100 g FW) by Alothman, Bhat, and Karim.³⁴ Peel total phenolic compound contents of A dessert bananas

(252.1-383.5 mg GAE/100 g FW) were similar to those of the export dessert banana Grand Nain at a ripe stage (2.6-3.1 g GAE/100g dry weight ~260-310 mg/100g FW) reported by González-Montelongo, Gloria Lobo, and González.33 Surprisingly, the cultivar Pelipita from the AB nonplantain cooking banana group showed the highest pulp total phenolic compound values (319.5 \pm 70.4 GAE/100 g FW) within our banana collection. A drastically lower value was reported by Ngoh Newilah et al.³⁶ for this genotype (46 μ g GAE/100 g dry weight ~0.02 mg GAE/100 g FW). This low value might have resulted from the fact that the samples were dried in oven, which might have provoked phenolic compound oxidation. The highest pulp total phenolic compound values of plantains were obtained for the French plantain Niangafelo (198.4 \pm 28.9 mg GAE/100 g FW) and the Horn plantain Moto Ebanga (182.1 \pm 27.4 mg GAE/100 g FW). These results show that bananas and plantains could be as important sources of phenolic compounds as other vegetables such as potato (3950 μ g GAE/g dry weight ~90.85 mg GAE/100 g FW),³⁷ bitter melon (143.6 \pm 8.4 mg GAE/100 g FW), and beetroot (257.2 \pm 0.7 mg GAE/100 g FW).38

Discriminant Analysis. A linear discriminant analysis was performed to point out the most relevant physicochemical attributes contributing to the differentiation between cultivar groups. Furthermore, this approach was also intended to help allocating each of the two new hybrids to one of the cultivar groups.

Figure 1 presents the scatterplot of the standardized discriminant scores (A) and the corresponding standardized scoring coefficients of the physicochemical attributes or loading plot (B). The 2 first discriminant functions (1 and 2) explain 79.23% of the variation between groups. These 2 first discriminant functions were found to be highly significant (P < 0.0001). The matrix generated by the software indicated that the number of samples correctly classified in the groups accounted for 92.6% of the samples involved in this analysis. The scatterplot shows that the dessert banana groups are separated from the cooking banana groups along the function 1 axis. On this axis, peel pH, pulp water content, edible fraction and fruit mass have the higher scoring coefficients in absolute terms, meaning that they were mostly responsible for this differentiation. The two groups of dessert bananas (A and AB) are separated according to function 2 axis, where pulp total phenolic compounds have the highest scoring coefficient. Pulp total phenolic compounds appear therefore to have highly contributed to the differentiation between the dessert bananas containing only the A genome (247.3 \pm 76.3 mg/100 g FW) and those containing both A and B genomes (103.7 \pm 33.2 mg/100 g FW). The nonplantain cooking bananas also split on the second axis: the A nonplantain cooking group has considerably higher scores on the second axis than the AB nonplantain cooking group. Furthermore, the AB nonplantain cooking group partly overlaps with the French and Horn plantain cooking groups, suggesting close physicochemical characteristics.

The comparison of the loading and the score plots of Figure 1 indicates that dessert bananas had the highest values of peel pH, edible fraction, and pulp water content whereas AB nonplantain cooking bananas and plantain cooking bananas had the lowest values for these attributes. It also appears that AB dessert bananas had the highest edible fraction values and A dessert bananas had the highest pulp water content values. The fact that the pulp water content mean value of the A dessert

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$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	$ \begin{array}{llllllllllllllllllllllllllllllllllll$	Yangambi km5	51.8	77	30.1	25.7	89.0	66.8	2.2	90.3	73.3	cul
Bigge fromme fators 544 803 355 354 803 355 354 803 355 354 803 355	Figer Former Ellona 544 803 335 167 755 705 707 14 716 23 Steir Velch 555<±32	D-AB	52.8 ± 3.8^{a}	80.3 ± 0.9^{a}	32.3 ± 1.7^{a}	24.4 ± 12.5^{b}	96.6 ± 40^{a}	76.2 ± 4^{a}	2.1 ± 0.7^{b}	89.1 ± 0.3^{a}	69.7 ± 5.3^{ab}	tu
Risk Order Size <	Safe Velori S55 ± 3.2 808 ± 0.7 3.29 ± 2 17.7 ± 0.5 70.7 ± 1.4 73.7 ± 0.6 14 ± 0.1 Rama 46.8 ± 4.5 73.5 \pm 3.9 12.7 10.6 ± 1.4 71.6 11.2 ± 1.6 Record 46.8 \pm 4.5 75.4 \pm 1.6 75.3 ± 2.9 11.5 ± 5.4 05.5 ± 3.8 20.6 ± 1.7 74.6 22.2 22.6 ± 0.1 Records 51.7 ± 3.5 23.4 ± 1.3 33.6 ± 1.3 22.2 ± 0.3 Mutubin 51.7 ± 1.6 73.4 ± 1.3 33.6 ± 1.3 33.6	Figue Pomme Ekona	54.4	80.9	33.6	16.7	76.5	78.1	2.8	88.8	65.5	ral
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Ram 455 793 303 849 1427 716 22 Relation 458.4.4.8 77.5.4.2.9 394.4.2.1 880.4.3.8.8 153.7 716 22 23 63 66 16 27 203 166 27 203 23 233.4.1.8 73.5.1.2.1 23.4.1.8 23.5.1.2.1 23.4.1.8 23.5.1.2.1 23.4.1.8 23.5.1.2.1 23.4.1.8 23.5.1.2.1 23.4.1.8 23.5.1.2.1 23.4.1.8	Safet Velchi	55.5 ± 3.2	80.8 ± 0.7	32.9 ± 2	17.7 ± 0.5	70.7 ± 1.4	78.7 ± 0.6	1.4 ± 0.1	89.4 ± 0.5	68.0 ± 1.4	an
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Rana	48.S	79.3	30.3	38.9	142.7	71.6	2.2	89.0	75.7	ld
Gradient 67 ± 15 753 ± 25 315 ± 354 675 ± 15 753 ± 256 315 ± 556 326 ± 566 <th< td=""><td>Kedian$457\pm 16$$795\pm 2.9$$315\pm 3.4$$605\pm 3.3$$2066\pm 14.7$$674\pm 2.2$$26\pm 0.1$Tenolo$31.7$$73.2$$33.2$$30.1$$74.6$$2.7$$2.7$$2.7$Tenolo$31.7$$73.5$$31.9\pm 3.57$$33.5\pm 1.5$$30.1$$74.6$$2.7$$2.7$Dvarf Kalpua$55.4\pm 4$$75.1\pm 2.1^8$$31.9\pm 3.57$$33.2\pm 1.6$$33.4\pm 1.6$$27.2$$27.2$Dvarf Kalpua$55.4\pm 4$$75.1\pm 2.1^8$$31.9\pm 3.57$$53.2\pm 5.1$$30.2\pm 1.6$$27.2$$27.2$Dvarf Kalpua$55.4\pm 4$$75.1\pm 2.1^8$$30.4\pm 4.5$$30.2\pm 1.6$$66.6\pm 1.3$$30.2\pm 0.2$Dvarf Kalpua$55.4\pm 4$$77.1\pm 1.4^{10}$$34.9\pm 1.3$$30.6\pm 1.6$$27.2$$23.2$Kupuik$51.9$$77.7$$32.2$$44.31$$06.6\pm 1.15$$56.4\pm 3$$30.2\pm 0.2$Kupuik$51.9$$77.7$$32.2$$44.31$$06.6\pm 1.15$$57.4\pm 0.2$Kupuik$51.9$$77.7$$34.9\pm 1.3$$30.6\pm 4.4^3$$11.2$$57.2\pm 0.2$Kupuik$50.4\pm 7$$77.1\pm 1.4^{10}$$28.4\pm 1.4$$00.5\pm 1.15$$66.5\pm 3.3$$33.2$Kupuik$57.2$$77.2\pm 1.2$$30.2\pm 1.7$$50.2\pm 1.1$$20.2\pm 0.1$Kupuik$57.2$$77.2\pm 1.2$$10.3\pm 1.7$$50.2\pm 1.2$$22.2$Kupuik$57.2$$77.2\pm 1.2$$10.3\pm 1.7$$50.2\pm 1.2$$22.2$Buanc$77.7$$25.6$$34.1$$30.7\pm 5.7$<!--</td--><td>NPC-A</td><td>46.8 ± 4.5^{a}</td><td>77.5 ± 3.4^{ab}</td><td>29.4 ± 2.1^{a}</td><td>38.0 ± 3.8^{ab}</td><td>188.3 ± 51.5^{a}</td><td>$70.6 \pm 3.7^{\rm ab}$</td><td>$2.5 \pm 0.3^{\rm ab}$</td><td>88.9 ± 1.1^{a}</td><td>69.0 ± 9.6^{abc}</td><td>Fo</td></td></th<>	Kedian 457 ± 16 795 ± 2.9 315 ± 3.4 605 ± 3.3 2066 ± 14.7 674 ± 2.2 26 ± 0.1 Tenolo 31.7 73.2 33.2 30.1 74.6 2.7 2.7 2.7 Tenolo 31.7 73.5 31.9 ± 3.57 33.5 ± 1.5 30.1 74.6 2.7 2.7 Dvarf Kalpua 55.4 ± 4 75.1 ± 2.1^8 31.9 ± 3.57 33.2 ± 1.6 33.4 ± 1.6 27.2 27.2 Dvarf Kalpua 55.4 ± 4 75.1 ± 2.1^8 31.9 ± 3.57 53.2 ± 5.1 30.2 ± 1.6 27.2 27.2 Dvarf Kalpua 55.4 ± 4 75.1 ± 2.1^8 30.4 ± 4.5 30.2 ± 1.6 66.6 ± 1.3 30.2 ± 0.2 Dvarf Kalpua 55.4 ± 4 77.1 ± 1.4^{10} 34.9 ± 1.3 30.6 ± 1.6 27.2 23.2 Kupuik 51.9 77.7 32.2 44.31 06.6 ± 1.15 56.4 ± 3 30.2 ± 0.2 Kupuik 51.9 77.7 32.2 44.31 06.6 ± 1.15 57.4 ± 0.2 Kupuik 51.9 77.7 34.9 ± 1.3 30.6 ± 4.4^3 11.2 57.2 ± 0.2 Kupuik 50.4 ± 7 77.1 ± 1.4^{10} 28.4 ± 1.4 00.5 ± 1.15 66.5 ± 3.3 33.2 Kupuik 57.2 77.2 ± 1.2 30.2 ± 1.7 50.2 ± 1.1 20.2 ± 0.1 Kupuik 57.2 77.2 ± 1.2 10.3 ± 1.7 50.2 ± 1.2 22.2 Kupuik 57.2 77.2 ± 1.2 10.3 ± 1.7 50.2 ± 1.2 22.2 Buanc 77.7 25.6 34.1 30.7 ± 5.7 </td <td>NPC-A</td> <td>46.8 ± 4.5^{a}</td> <td>77.5 ± 3.4^{ab}</td> <td>29.4 ± 2.1^{a}</td> <td>38.0 ± 3.8^{ab}</td> <td>188.3 ± 51.5^{a}</td> <td>$70.6 \pm 3.7^{\rm ab}$</td> <td>$2.5 \pm 0.3^{\rm ab}$</td> <td>88.9 ± 1.1^{a}</td> <td>69.0 ± 9.6^{abc}</td> <td>Fo</td>	NPC-A	46.8 ± 4.5^{a}	77.5 ± 3.4^{ab}	29.4 ± 2.1^{a}	38.0 ± 3.8^{ab}	188.3 ± 51.5^{a}	$70.6 \pm 3.7^{\rm ab}$	$2.5 \pm 0.3^{\rm ab}$	88.9 ± 1.1^{a}	69.0 ± 9.6^{abc}	Fo
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	Translo 31 ± 13 79 ± 17 27 ± 6 398 ± 18 2352 ± 429 66 ± 16 27 ± 03 Mutha 317 735 294 51 ± 33 375 ± 36 105 ± 1357 625 ± 16 22 ± 02 Mutha 517 735 ± 29^{2} 51 ± 12^{1} 310 ± 33^{2} 375 ± 36^{2} 105 ± 1357 655 ± 51 22 ± 02^{2} Pelipia 85 ± 29^{2} 75 ± 17^{2} 308 ± 53 333 ± 15 105 ± 1357 655 ± 51 21 ± 02^{2} Pelipia 85 ± 29^{2} 75 ± 12^{1} 310 ± 33^{2} 353 ± 15 105 ± 176 655 ± 51 22 ± 02^{2} Pelipia 537 ± 16 74 ± 18 302 ± 23 332 ± 15 403 ± 113 665 ± 3 32 ± 04 327 ± 16 72 ± 114^{4} 284 ± 74^{2} 365 ± 14 206 ± 182 0.23 ± 11 30 ± 02 Lakmon 304 ± 7^{7} $77\pm 1\pm 14^{6}$ 284 ± 74^{2} 365 ± 14 206 ± 182 0.23 ± 12 23 ± 03 1067 $80\pm 23\pm 11$ 75 ± 16 34 ± 11 35 ± 14 433 1365 665 ± 3 23 ± 03 1067 $80\pm 23\pm 10$ 32 Nu then 1 $33\pm 4\pm 16$ 34 ± 13 36 ± 14 206 ± 182 $0.65\pm 23\pm 03$ 31 ± 13 72 ± 2 75 ± 12 103 ± 11 437 ± 12 1036 $665\pm 23\pm 03$ 23 1067 35 ± 13 72 ± 2 72 ± 13 $106, 73$ 99 ± 26 13 23 ± 03 1067 86 ± 13 100 ± 03 10 ± 03 10 ± 03 10 ± 03 10 ± 0	Kekiau	45.7 ± 1.6	79.5 ± 2.9	31.5 ± 3.4	40.5 ± 3.8	206.6 ± 14.7	67.4 ± 2.2	2.6 ± 0.1	89.3 ± 0.7	62.8 ± 0.6	od
	Mujuda S17 7.3.5 2.94 33.6 13.01 7.4.6 2.2 NUCAR 5.5.4 ± 27 7.5.1 ± 2.1° 3.1.4 ± 2.1° 3.1.2 ± 2.1° 2.2 2.1.4 ± 0.4° NuCAR 5.5.4 ± 2.0° 7.5.1 ± 2.1° 3.1.4 ± 2.0° 3.1.4 ± 0.4° 2.1.4 \pm 0.4° 2.1.7 ± 2.9°	Tomolo	43 ± 1.3	79.4 ± 1.7	27.4 ± 6	39.8 ± 1.8	228.2 ± 42.9	69.6 ± 1.6	2.7 ± 0.3	89.7 ± 0.6	64.1 ± 1.6	Cł
RevCAB 53.2 ± 2.9 53.1 ± 2.1^3 50.2 ± 1.0^3 57.3 ± 2.5^3 64.2 ± 6.0^{10} 10.2 ± 1.0^{10} 57.3 ± 2.5^3 64.2 ± 6.0^{10} 10.2 ± 1.0^{10} 57.3 ± 2.5^3 64.2 ± 6.0^{10} 10.2 ± 1.0^{10} 57.3 ± 1.5^3 56.4 ± 1.0^{10} 56.2 ± 1.1^{10}	NFC-AB $5.5.\pm 2.9^{\circ}$ $7.5.\pm 2.1^{\circ}$ 3.19 ± 3.2 $3.7.\pm 3.6^{\circ}$ $2.0.3\pm 1.5^{\circ}$ $6.7.\pm 3.9^{\circ}$ $3.1\pm 0.4^{\circ}$ Dwarf Kalpun 5.4 ± 4 7.6 ± 1.5 $3.0.\pm 5.5$ $3.0.\pm 0.2\pm 0.2\pm 0.2\pm 0.2\pm 0.2\pm 0.2\pm 0.2\pm $	Mujuba	51.7	73.5	29.4	33.6	130.1	74.6	2.2	87.6	80.1	her
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \begin{array}{llllllllllllllllllllllllllllllllllll$	NPC-AB	52.5 ± 2.9^{a}	$75.1 \pm 2.1^{\rm b}$	31.9 ± 3.2^{a}	37.7 ± 3.9^{ab}	210.3 ± 135.7^{a}	62.7 ± 3.9^{bc}	3.1 ± 0.4^{a}	87.3 ± 2.5^{a}	64.0 ± 4.6^{bcd}	nis
Pellpin 63 ± 3.6 73 ± 2.1 73 ± 2.1 73 ± 2.1 73 ± 2.1 73 ± 2.1 90 ± 4.0 80 ± 1.1 80 ± 1.1 90 ± 4.0 80 ± 1.1 <	Peliptia 483 ± 3.6 739 ± 2.1 272 ± 4 400 ± 4.5 130.2 ± 10 63.4 ± 1 30.2 ± 0.4 Ropulik 5.7 ± 16 7.4 ± 1.8 346 ± 2.5 438 ± 1.6 6.65 ± 3.3 3.0 ± 0.4 Kupulik 5.19 7.2 3.9 ± 1.7 3.54 ± 1.4 2064 ± 1.82 6.65 ± 3.3 3.0 ± 0.2 Kupulik 5.11 7.2 7.1 ± 1.4^{40} 284 ± 7.4^{4} 396 ± 4.3^{2} 1669 ± 11.5 6.65 ± 3.8 3.8 French Rouge 18 5.44 ± 1.5 77.1 ± 1.4^{40} 28.64 ± 7.4^{2} 396 ± 4.3^{2} 136.3 ± 2.84^{4} 61.7 ± 2.9^{6} 2.8 ± 0.2^{40} French Rouge 18 5.44 ± 1.5 75.4 ± 1.5 75.4 ± 1.2 107.0 ± 5.7 $6.3 \pm 2.8 \pm 0.2^{40}$ Mote 1 5.72 ± 7.66 3.41 3.90 ± 1.5 67.2 ± 1.2 2.8 ± 0.2^{40} Rouge de Lourn 57.2 76.6 3.41 320 ± 4.7 30.0 ± 5.7 61.3 ± 2.2^{40} Rouge de Lourn 57.2 76.6 3.41 32.0 ± 1.0 107.0 ± 5.7 61.3 ± 1.7 3.0 ± 0.2 Rouge de Lourn 57.2 76.5 3.41 32.0 ± 1.0 107.0 ± 5.7 61.8 ± 1.7 3.0 ± 0.2 Rouge de Lourn 57.2 76.5 $3.31.4$ 32.0 ± 1.0 107.0 ± 5.7 61.8 ± 1.7 $30.\pm 0.2$ Rouge de Lourn 57.2 77.7 33.0 23.2 ± 1.0 53.8 ± 2.0 53.8 ± 2.0 53.8 ± 0.2 Rouge de Lourn 57.2 ± 3.0 50.5 ± 3.2 107.0 ± 5.7 58.8 ± 2.6	Dwarf Kalapua	56.4 ± 4	76.4 ± 1.5	30.8 ± 5.8	33.3 ± 1.5	105.1 ± 17.6	56.3 ± 5.1	2.7 ± 0.2	84.7 ± 0.8	60.5 ± 1	stry
	In-U-Machi 3.7 ± 1.6 7.4 ± 1.8 3.6 ± 2.5 39.8 ± 1.9 166.9 ± 11.5 64.6 ± 3 3.0 ± 0.4 Kapplik 3.19 $7.$ 3.2 41.5 44.31 66.5 3.8 3.8 Lahron 5.1 ± 1.2 78 ± 1.6 $3.24 \pm 7.4^{\circ}$ 3.6 ± 1.4 3.6 ± 1.82 $6.6.5 \pm 3.8$ 3.8 Lahron 5.1 ± 1.1 78 ± 1.6 $3.24 \pm 7.4^{\circ}$ $3.6.6 \pm 4.3$ $3.6.8 \pm 1.11$ $5.9 \pm 0.2^{\circ}$ French Rouge 18 54.8 77 $2.6.4$ $2.6.8$ 41.3 $136.3 \pm 2.84^{\circ}$ $61.7 \pm 2.9^{\circ}$ $2.8 \pm 0.2^{\circ}$ Nite 9.99 76.4 $2.6.8$ 41.3 $136.3 \pm 2.84^{\circ}$ $61.7 \pm 2.9^{\circ}$ $2.8 \pm 0.2^{\circ}$ Meth 37.2 76.4 $2.6.8$ 3.81 316.4 ± 1.7 $51.7 \pm 2.9^{\circ}$ $2.8 \pm 0.2^{\circ}$ Meth 77.2 75.6 3.41 37.2 ± 1.3 107.0 ± 5.7 61.8 ± 1.7 3.0 ± 0.3 Star Nogu 45.7 ± 2.7 73.2 ± 1.3 107.0 ± 5.7 61.8 ± 1.7 3.0 ± 0.3 Red Yack 56.9 ± 1 76.6 ± 2.3 33.3 ± 3.5 37.8 ± 0.5 $110.2 \pm 0.6 \pm 0.1$ Red Yack 56.9 ± 1 76.6 ± 2.3 33.3 ± 3.5 37.8 ± 0.5 38.1 ± 0.7 Red Yack 56.9 ± 1 $76.2 \pm 2.9^{\circ}$ 23.8 ± 0.5 38.1 ± 0.7 Red Yack 56.9 ± 1.2 77.4 37.4 ± 1.3 107.0 ± 5.7 56.8 ± 2.6 2.8 ± 0.2 Red Yack 56.9 ± 1.2 77.4 37.4 ± 1.3 107.0 ± 5.7	Pelipita	48.3 ± 3.6	73.9 ± 2.1	27.2 ± 4	40.0 ± 4.5	130.2 ± 10	63.4 ± 1	3.0 ± 0.2	86.2 ± 1.1	59.4 ± 0.5	/
Kupulk5197.23.2.241.543.166.53.886.161.41.9Lahano30.4 \pm^7 77.1 \pm 1.4°39.4 \pm 1.336.6 \pm 4.8.26.3.2 \pm 1.12.9 \pm 0.386.16.4 \pm 1.9Lahano30.4 \pm^7 77.1 \pm 1.4°38.4 \pm 7.436.6 \pm 4.8.26.3.2 \pm 1.12.9 \pm 0.387.7 \pm 1.4°6.4 \pm 1.9Fencih Range 1854.877.1 \pm 1.4°38.4 \pm 7.713.6.8 \pm 3.8.46.3.2 \pm 2.289.3 \pm 0.36.16.1Mat39.47.53.87.413.6.8 \pm 3.8.413.6.8 \pm 3.8.46.3.2 \pm 2.289.3 \pm 0.36.1Mat57.27.5 ± 12.9 ± 0.38.7 \pm 1.1°5.6.7 \pm 2.2.2 \pm 0.389.3 \pm 0.36.14.1Neu6.6 ± 3.1 3.9010.7 \pm 1.210.0 \pm 1.1°6.7 \pm 2.2.2 \pm 0.389.3 \pm 0.36.14.1Rouge de Lom57.27.5 ± 1.27.3 \pm 1.110.7 \pm 1.79.97.2 \pm 1.110.6 \pm 1.79.95.1Rouge de Lom57.27.5 ± 1.27.3 \pm 1.110.7 \pm 1.110.7 \pm 1.210.7 \pm 2.22.2 \pm 0.38.9 \pm 1.16.1 \pm 1.9°Rouge de Lom57.42.63.1 ± 1.17.7 \pm 1.110.7 \pm 2.22.3 \pm 0.28.7 \pm 1.16.1 \pm 1.9°Rouge de Lom57.42.8 \pm 1.05.0 \pm 1.17.2 \pm 1.17.2 \pm 1.17.2 \pm 1.16.1 \pm 1.9°Rouge de Lom57.42.8 \pm 1.17.5 \pm 1.17.2 \pm 1.17.2 \pm 1.17.2 \pm 1.28.7 \pm 1.1Rouge de Lom <td< td=""><td>Kupulik5197232.241.544.3166.53.8Lakano$2.1 \pm 1.1$$78 \pm 1.6$$3.9 \pm 1.7$$3.6 \pm 1.4$$2.66 \pm 4.8^2$$6.3 \pm 2.1^3$$2.9 \pm 0.3^3$Lakano$5.1 \pm 1.1$$78 \pm 1.6$$3.90 \pm 1.7$$13.65 \pm 1.4$$2.66 \pm 4.8^2$$6.17 \pm 2.9^6$$2.8 \pm 0.2^3$PCFPench$5.48$$4.13$$13.65 \pm 1.4$$2.66 \pm 4.3^3$$13.65 \pm 2.8^4$$0.3$$2.7$Nite$9.9$$7.64$$2.68$$4.13$$17.14$$6.1.7 \pm 2.9^6$$2.8 \pm 0.2^3$Meta$37.2$$7.95 \pm 1.9$$5.62 \pm 3.4$$3.81 \pm 3.2$$10.94 \pm 1.5$$6.7 \pm 2.9^6$$2.8 \pm 0.3$Nite$77.2$$7.66$$3.1 \pm 3.2$$10.94 \pm 1.5$$6.7 \pm 2.9^6$$2.8 \pm 0.3$Rouge de Loum$77.2$$7.65$$2.04 \pm 4.7$$37.2 \pm 1.3$$107.0 \pm 5.7$$6.18 \pm 1.7$$3.0 \pm 0.3$Rouge de Loum$77.2$$7.65$$2.88 \pm 4.31$$1.93.9$$6.7 \pm 2.9^6$$2.8 \pm 0.2$Kar Ngou$4.27$$7.65$$2.88 \pm 4.31$$1.93.9$$6.92 \pm 2.8$$2.8 \pm 0.2$Kar Ngou$4.77$$3.7$$37.2 \pm 1.3$$37.2 \pm 3.3$$3.9 \pm 2.6$$2.8 \pm 0.2$Kar Ngou$4.77$$3.7 \pm 3.7$$37.2 \pm 1.3$$37.2 \pm 2.8$$2.8 \pm 0.2$Kar Ngou$5.64$$7.8$$4.31$$1.37$$37.2 \pm 2.8$$2.8 \pm 0.2$Kar Ngou$5.64$$7.8 \pm 4.8^3$$2.8 \pm 1.6^2$$3.6 \pm 0.1$Batarid$5.64$$7.8 \pm 2.8$</td><td>Iho-U-Maohi</td><td>53.7 ± 1.6</td><td>74.4 ± 1.8</td><td>34.6 ± 2.5</td><td>39.8 ± 1.9</td><td>166.9 ± 11.5</td><td>64.6 ± 3</td><td>3.0 ± 0.4</td><td>90.9 ± 0</td><td>69.8 ± 1.1</td><td></td></td<>	Kupulik5197232.241.544.3166.53.8Lakano 2.1 ± 1.1 78 ± 1.6 3.9 ± 1.7 3.6 ± 1.4 2.66 ± 4.8^2 6.3 ± 2.1^3 2.9 ± 0.3^3 Lakano 5.1 ± 1.1 78 ± 1.6 3.90 ± 1.7 13.65 ± 1.4 2.66 ± 4.8^2 6.17 ± 2.9^6 2.8 ± 0.2^3 PCFPench 5.48 4.13 13.65 ± 1.4 2.66 ± 4.3^3 13.65 ± 2.8^4 0.3 2.7 Nite 9.9 7.64 2.68 4.13 17.14 $6.1.7 \pm 2.9^6$ 2.8 ± 0.2^3 Meta 37.2 7.95 ± 1.9 5.62 ± 3.4 3.81 ± 3.2 10.94 ± 1.5 6.7 ± 2.9^6 2.8 ± 0.3 Nite 77.2 7.66 3.1 ± 3.2 10.94 ± 1.5 6.7 ± 2.9^6 2.8 ± 0.3 Rouge de Loum 77.2 7.65 2.04 ± 4.7 37.2 ± 1.3 107.0 ± 5.7 6.18 ± 1.7 3.0 ± 0.3 Rouge de Loum 77.2 7.65 2.88 ± 4.31 $1.93.9$ 6.7 ± 2.9^6 2.8 ± 0.2 Kar Ngou 4.27 7.65 2.88 ± 4.31 $1.93.9$ 6.92 ± 2.8 2.8 ± 0.2 Kar Ngou 4.77 3.7 37.2 ± 1.3 37.2 ± 3.3 3.9 ± 2.6 2.8 ± 0.2 Kar Ngou 4.77 3.7 ± 3.7 37.2 ± 1.3 37.2 ± 2.8 2.8 ± 0.2 Kar Ngou 5.64 7.8 4.31 1.37 37.2 ± 2.8 2.8 ± 0.2 Kar Ngou 5.64 7.8 ± 4.8^3 2.8 ± 1.6^2 3.6 ± 0.1 Batarid 5.64 7.8 ± 2.8	Iho-U-Maohi	53.7 ± 1.6	74.4 ± 1.8	34.6 ± 2.5	39.8 ± 1.9	166.9 ± 11.5	64.6 ± 3	3.0 ± 0.4	90.9 ± 0	69.8 ± 1.1	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	LakinoS21 ± 1.1 78 ± 1.6 349 ± 1 3.56 ± 1.4 2.064 ± 18.2 6.32 ± 1.1 2.9 ± 0.3^4 French Rouge 18 5.04 ± 7^7 77.1 ± 1.4^8 2.84 ± 7.4^4 3.56 ± 4.3^3 $13.68 \pm 2.8.4^6$ 61.7 ± 2.9^6 2.8 ± 0.2^{16} French Rouge 18 5.94 ± 7.7 2.86 4.13 $13.68 \pm 2.8.4^6$ 61.7 ± 2.9^6 2.8 ± 0.2^{16} Meta 1 57.2 75.4 ± 1.9 56.2 ± 3.4 38.1 ± 3.2 10.14 ± 6.7 5.8 ± 0.3 3.2 Banne Tigree 37 ± 2 74.4 ± 1.9 56.2 ± 3.4 38.1 ± 3.2 10.07 ± 5.7 6.13 3.2 ± 0.3 Banne Tigree 37 ± 2 74.4 ± 1.9 50.2 ± 4.7 37.2 ± 1.3 10.70 ± 5.7 6.18 ± 1.7 3.0 ± 0.3 Banne Tigree 37 ± 2 74.4 ± 1.9 25.0 ± 4.7 37.2 ± 1.3 10.70 ± 5.7 6.18 ± 1.7 3.0 ± 0.3 Banne Tigree 37 ± 2 74.4 ± 1.9 25.0 ± 4.7 37.2 ± 1.3 110.0 ± 6.7 58.8 ± 2.6 2.8 ± 0.2 Banne Tigree 37 ± 2 74.4 ± 1.3 10.3 ± 5.6 10.7 ± 5.7 50.6 ± 1.8 50.6 ± 1.8 50.6 ± 1.6 20.6 ± 1.6 Rei Yade 56.6 ± 1.7 $31.2 \pm 1.2.1^3$ 75.4 ± 2.3 33.3 ± 3.5 35.4 ± 3.5^6 53.2 ± 0.2 Banne Tigree 56.9 ± 1.6 56.9 ± 1.6 53.2 ± 0.7 30.4 ± 0.3 56.6 ± 6.8^3 23.2 ± 0.4 Meti 56.4 ± 1.6 55.2 ± 2.1 32.4 ± 0.2 56.6 ± 2.8 32.4 ± 0.4 Meti 56.4 ± 1.8 </td <td>Kupulik</td> <td>51.9</td> <td>72.</td> <td>32.2</td> <td>41.5</td> <td>443.1</td> <td>66.5</td> <td>3.8</td> <td>86.1</td> <td>68.1</td> <td></td>	Kupulik	51.9	72.	32.2	41.5	443.1	66.5	3.8	86.1	68.1	
FCFeneth $50.4 \pm 7^*$ 77.1 ± 1.4^8 $28.4 \pm 7^*$ $136.5 \pm 106^*$ 61.7 ± 2.9^6 2.8 ± 0.2^8 81.4 ± 1.8^6 61.4 ± 1.9^{41} French Ruoge 18 9.3 7.4 2.8 41.3 136.3 60.3 2.7 89.3 61.4 ± 1.9^{41} French Ruoge 18 9.3 ± 1.5 755 ± 1.9 86.2 ± 3.4 811 ± 3.2 1064 ± 1.5 67.2 ± 1.2 89.3 ± 0.3 64.7 ± 2 Mean 77.2 74.5 ± 1.2 10.3 ± 1.4 81.2 ± 1.2 10.4 ± 1.0^{41} 61.3 ± 1.2 61.7 ± 1.2 <t< td=""><td>PC-French$50, 4\pm 7^{*}$$77.1\pm 1.4^{*0}$$28, 4\pm 7.4^{*}$$39, 6\pm 4.3^{*}$$156.8\pm 2.84^{*}$$61.7\pm 2.9^{*}$$28\pm 4.2^{*0}$French Rouge 18$54.8$$77.1\pm 1.4^{*0}$$26.8$$41.3$$156.3$$60.3$$2.7$$2.2$Mete1$39.9$$76.4$$26.8$$41.3$$169.4\pm 1.5$$61.7\pm 2.9^{*}$$2.8\pm 0.3$Mete1$57.2$$75.5$$34.1$$30.2$$167.3$$61.3$$3.2$$2.8\pm 0.3$Banne Tigree$37\pm 2$$74.5$$36.2\pm 3.4$$39.0$$167.3$$58.1$$3.2$$2.8\pm 0.2$Kar Ngou$43.5\pm 3$$78.4\pm 1.9$$25.0\pm 4.7$$37.2\pm 1.3$$110.0\pm 6.7$$58.8\pm 2.6$$2.8\pm 0.2$Kar Ngou$47.5$$37.2\pm 1.2$$10.3\pm 1$$4.37\pm 1.2$$110.0\pm 6.7$$58.8\pm 2.6$$2.8\pm 0.2$Kar Ngou$47.5\pm 3$$76.4\pm 1.9$$25.0\pm 4.7$$37.2\pm 1.3$$107.0\pm 5.7$$61.8\pm 1.7$$3.0\pm 0.3$Kalong Mekintu$51.7$$77.4\pm 31.4$$44.3$$99.4$$58.6$$2.8\pm 0.3$Meti$56.9\pm 1$$76.4\pm 1.3$$31.4\pm 0.3$$52.5\pm 3.3$$34.6\pm 0.3$Red Yade$56.9\pm 1$$76.4\pm 2.3$$33.3\pm 2.53$$56.8\pm 2.35$$56.8\pm 2.35$$2.8\pm 0.3$Meti$56.9\pm 1$$77.4\pm 3.3$$31.8\pm 0.7$$52.8\pm 3.3$$56.8\pm 2.35$$2.8\pm 0.3$Meti$56.9\pm 1$$77.4\pm 3.3$$33.3\pm 2.53$$56.8\pm 2.45\pm 0.3$$36.6\pm 0.3$$33.2\pm 0.4$Mourrenciou no.1$63.9\pm 2.5$<t< td=""><td>Laknao</td><td>52.1 ± 1.1</td><td>78 ± 1.6</td><td>34.9 ± 1</td><td>33.6 ± 1.4</td><td>206.4 ± 18.2</td><td>62.8 ± 1.1</td><td>2.9 ± 0.3</td><td>88.7 ± 1.1</td><td>62.4 ± 1.2</td><td></td></t<></td></t<>	PC-French $50, 4\pm 7^{*}$ $77.1\pm 1.4^{*0}$ $28, 4\pm 7.4^{*}$ $39, 6\pm 4.3^{*}$ $156.8\pm 2.84^{*}$ $61.7\pm 2.9^{*}$ $28\pm 4.2^{*0}$ French Rouge 18 54.8 $77.1\pm 1.4^{*0}$ 26.8 41.3 156.3 60.3 2.7 2.2 Mete1 39.9 76.4 26.8 41.3 169.4 ± 1.5 $61.7\pm 2.9^{*}$ 2.8 ± 0.3 Mete1 57.2 75.5 34.1 30.2 167.3 61.3 3.2 2.8 ± 0.3 Banne Tigree 37 ± 2 74.5 36.2 ± 3.4 39.0 167.3 58.1 3.2 2.8 ± 0.2 Kar Ngou 43.5 ± 3 78.4 ± 1.9 25.0 ± 4.7 37.2 ± 1.3 110.0 ± 6.7 58.8 ± 2.6 2.8 ± 0.2 Kar Ngou 47.5 37.2 ± 1.2 10.3 ± 1 4.37 ± 1.2 110.0 ± 6.7 58.8 ± 2.6 2.8 ± 0.2 Kar Ngou 47.5 ± 3 76.4 ± 1.9 25.0 ± 4.7 37.2 ± 1.3 107.0 ± 5.7 61.8 ± 1.7 3.0 ± 0.3 Kalong Mekintu 51.7 77.4 ± 31.4 44.3 99.4 58.6 2.8 ± 0.3 Meti 56.9 ± 1 76.4 ± 1.3 31.4 ± 0.3 52.5 ± 3.3 34.6 ± 0.3 Red Yade 56.9 ± 1 76.4 ± 2.3 33.3 ± 2.53 56.8 ± 2.35 56.8 ± 2.35 2.8 ± 0.3 Meti 56.9 ± 1 77.4 ± 3.3 31.8 ± 0.7 52.8 ± 3.3 56.8 ± 2.35 2.8 ± 0.3 Meti 56.9 ± 1 77.4 ± 3.3 33.3 ± 2.53 $56.8\pm 2.45\pm 0.3$ 36.6 ± 0.3 33.2 ± 0.4 Mourrenciou no.1 63.9 ± 2.5 <t< td=""><td>Laknao</td><td>52.1 ± 1.1</td><td>78 ± 1.6</td><td>34.9 ± 1</td><td>33.6 ± 1.4</td><td>206.4 ± 18.2</td><td>62.8 ± 1.1</td><td>2.9 ± 0.3</td><td>88.7 ± 1.1</td><td>62.4 ± 1.2</td><td></td></t<>	Laknao	52.1 ± 1.1	78 ± 1.6	34.9 ± 1	33.6 ± 1.4	206.4 ± 18.2	62.8 ± 1.1	2.9 ± 0.3	88.7 ± 1.1	62.4 ± 1.2	
French Rouge 18 548 77 286 413 1363 603 27 873 631 Nite 39.9 764 288 413 71.4 613 32.3 87.7 613 Nite 37.4 73.5 74.5 34.1 37.2 73.4 13.4 67.3 32.3 87.7 61.3 Rouge dt Loum 57.4 74.5 11.0 67.3 58.1 3.2 87.7 61.3 Banage Tigge 37.4 74.4 10 110.4 67.3 58.1 3.2 87.7 63.1 Rouge de Loum 57.4 76.5 28.4 10.1 45.7 58.4 50.2 52.4 Rouge de Loum 57.4 76.5 28.4 50.4	French Rouge 185487728.641.3136.360.32.7Nite q_{99} 76.4 26.8 q_{118} 171.4 61.3 3.2 Nite q_{99} 76.4 26.8 q_{118} 171.4 61.3 3.2 Rouge de Loum 57.2 75.6 $3.4.1$ 37.2 16.7 $8.1.3$ 3.2 Rouge de Loum 57.2 76.6 $3.4.1$ $37.2.1$ $107.6.5$ $58.1.2$ $3.2.4.03$ Banne Tigree $37.2.2$ 76.6 $3.4.1$ $37.2.1.2$ $107.0.4.5.7$ $61.8.\pm1.7$ $3.0.\pm0.3$ Banne Tigree $37.2.2$ 76.5 $25.8.4$ $43.1.1$ $110.0.6.7$ $59.8.\pm2.6$ $2.8.4.0.3$ French Sombre $4.2.7$ 76.5 $25.8.4.4.7$ $37.2.\pm1.3$ $107.0.4.5.7$ $61.8.\pm1.7$ $3.0.\pm0.3$ Medi 51.7 77.4 31.4 $4.3.1.1.8.0.6$ $64.9.9.2.5$ $2.8.4.0.3$ Red Vade 56.6 77.7 $33.3.3.5.3$ $37.8.0.5$ $64.8.\pm4.5^{16}$ $3.1.\pm0.4^{16}$ Modei 51.7 77.4 $31.4.4.4.3.2.7.5.5.2.8.3$ $64.8.\pm4.5^{16}$ $3.1.\pm0.4^{16}$ Red Vade 56.4 77.4 $33.4.5.3$ $36.6.\pm6.8^{16}$ $2.10.9.2.2.5.8.3.3.5.5.2.8.3.3.5.5.3.5.5.2.8.3.3.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5.5$	PC-French	50.4 ± 7^{a}	$77.1 \pm 1.4^{\mathrm{ab}}$	28.4 ± 7.4^{a}	39.6 ± 4.3^{a}	136.8 ± 28.4^{a}	61.7 ± 2.9^{c}	2.8 ± 0.2^{ab}	87.4 ± 1.8^{a}	61.4 ± 1.9^{cd}	
Nite 99 764 268 41.8 1714 61.3 32.2 87.7 61.3 Meta 1 3.34 ± 1.5 79 ± 1.9 $36.\pm3.4$ 831 ± 3.2 1004 ± 1.5 67.2 ± 1.2 2.8 ± 0.3 89.3 ± 0.3 61.3 61.7 ± 2 Meta 1 5.34 ± 1.5 79.5 ± 1.9 30.2 ± 1.4 83.7 ± 3.2 100.4 ± 1.5 67.2 ± 1.2 2.8 ± 0.3 89.3 ± 0.3 64.7 ± 2 64.7 ± 2 Range flame 77 ± 2 74.5 53.2 ± 1.3 100.0 ± 5.7 61.8 ± 1.7 30.2 89.3 ± 0.1 64.7 ± 2 62.4 ± 2.3 59.9 ± 2.2	Nite 499 764 268 41.8 171.4 61.3 3.2 Mbera I 534 ± 1.5 795 ± 1.9 362 ± 3.4 381 ± 3.2 1694 ± 1.5 672 ± 1.2 28 ± 0.3 Morea I 57.2 76.6 34.1 390 167.3 581 ± 2.6 28 ± 0.2 Banne Tigree 37.2 743 ± 1.2 10.3 ± 1 457 ± 1.2 111.0 ± 6.7 588 ± 2.6 28 ± 0.2 Kar Ngou 42.7 76.5 25.0 ± 4.7 37.2 ± 1.3 1309 ± 6.49 2.5 30 ± 0.3 Kar Ngou 42.7 76.5 25.8 43.1 1309 64.9 2.5 Medi 51.7 77.4 31.4 44.3 93.4 58.9 2.6 0.1 Red Yade 56.6 ± 1.6 33.3 ± 3.5 37.8 ± 0.5 33.9 ± 3.2 52.8 ± 3.9 2.6 ± 0.1 Red Yade $55.12 \pm 1.2.1^4$ 76.5 ± 2.8 33.4 ± 3.8 40.5 2.5 ± 6.6 2.9 <	French Rouge 18	54.8	77	28.6	41.3	136.3	60.3	2.7	89.3	63.1	
Meta S3.4 ± 15 95.2 ± 19 36.2 ± 34 38.1 ± 32 169.4 ± 15 67.2 ± 12 28 ± 0.3 89.3 ± 0.3 66.7 ± 2 Banne Tigree 77.2 76.6 34.1 39.0 167.3 88.1 53.2 89.3 ± 56 53.0 ± 57 56.4 57.2 76.5 52.8 ± 4.7 37.2 ± 13 107.0 ± 57 61.8 ± 1.7 $30.2 - 0.3$ 88.2 ± 2.3 59.9 ± 2.2 58.0 ± 0.1 Kar Ngou 43.7 ± 13 107.0 ± 57 61.8 ± 1.7 30.2 88.7 ± 0.3 58.0 ± 0.1 Karends Sombre 42.7 77.7 31.4 43.3 93.4 58.0 58.2 ± 2.3 58.0 ± 0.1 Kalong Meikun 56.6 77.7 31.4 43.3 93.4 58.2 58.2 50.3 58.2 ± 0.7 60.3 ± 1.4^4 Mole 51.7 77.4 33.4 ± 3.4 190.2 22.3 ± 2.3 58.2 ± 0.7 60.3 50.3 50.3 50.3 ± 1.4^4 50.3 ± 1.4^4 50.3 ± 1.4^4 50.3	Mbeti 1 534 ± 15 795 ± 19 562 ± 34 381 ± 32 1694 ± 15 672 ± 12 2.8 ± 0.3 Rouge de Loum 572 766 34.1 39.0 167.3 58.1 2.8 ± 0.2 Banne Tigree 37 ± 2 74 ± 1.9 2.03 ± 1.1 30.0 167.3 58.1 3.2 ± 0.2 Banne Tigree 37 ± 2 74.3 ± 1.2 10.3 ± 1 4.37 ± 1.2 111.0 ± 6.7 59.8 ± 2.6 2.8 ± 0.2 Banne Tigree 37 ± 2 74 ± 1.9 2.50 ± 4.7 37.2 ± 1.3 10.7 ± 5.7 59.8 ± 2.6 2.8 ± 0.2 Kelong Melinu 566 77.7 33.0 29.7 130.9 64.9 2.5 Meli 51.7 77.4 31.4 44.3 93.4 58.0 2.8 Meli 51.7 77.4 31.4 44.3 93.4 58.0 2.6 ± 0.1 Relow Melinu 51.2 ± 12.1^{2} 76.2 ± 2^{20} 33.6 ± 6.8^{40} 221.9 ± 83.2^{2} 64.8 ± 4.5^{16} 3.1 ± 0.4^{4} Batrid 56.4 75.4 33.4 ± 3.3 37.8 ± 0.5 119.02 52.9 2.9 ± 0.2 Mouronkou no. 1 63.9 ± 2.5 75.8 ± 1.4 33.4 ± 3.3 36.4 ± 4.5^{16} 3.1 ± 0.4^{4} Batrid 56.4 75.4 33.4 ± 3.3 36.4 ± 2.3 36.4 ± 0.3 Mouronkou no. 1 63.9 ± 2.5 75.2 ± 2.4 23.9 2.6 ± 0.1 Mouronkou no. 1 63.9 ± 2.5 75.4 ± 2.4 23.2 ± 3.7 56.1 ± 2.4 2.9 ± 0.2 M	Ntie	49.9	76.4	26.8	41.8	171.4	61.3	3.2	87.7	61.3	
Rouge de Loum57276.634.1390167.358.13.287.92287.922.4Banne Tigee 37 ± 2 743 ± 12 103 ± 1 477 ± 12 1110 ± 67 598 ± 2.6 28.8 ± 0.2 88.7 0.21 Banne Tigee 37 ± 2 78.4 ± 10 203 ± 4.7 310 ± 57 518 ± 1.7 330 ± 0.2 88.6 ± 0.1 88.6 ± 0.1 Funch Sonbre 42.7 75.3 23.8 ± 4.1 31.0 50.4 ± 7.2 33.8 ± 0.9 58.0 ± 0.1 Kalong Mekintu 56.6 77.7 33.0 29.7 1000 ± 5.7 64.9 2.5 88.7 0.1 Med 56.7 77.7 33.0 29.7 1002 56.6 ± 2.3 33.4 ± 3.5 57.8 ± 0.7 61.3 ± 1.7 Med 56.4 55.4 77.4 33.8 49.9 1002 66.2 23.1 ± 0.4^{4} 86.6 ± 2^{2} 60.8 ± 1.4^{4} Med 56.4 75.4 33.8 41.9 1002 65.2 2.9 86.7 ± 2.7 60.2 11.7 ± 1 Med 56.4 75.4 33.8 ± 0.8 56.2 25.2 88.7 ± 0.7 61.3 ± 1.7^{4} Med 56.4 75.4 33.4 ± 3.8 64.8 ± 4.5^{16} 31.1 ± 0.4^{4} 86.6 ± 2^{2} 60.8 ± 1.4^{4} Med 56.4 75.4 33.8 ± 0.7 56.2 ± 2.2 86.7 ± 2.9 90.7 ± 1.3 50.7 ± 1.4^{4} Menoluon un 65.9 ± 2.5 75.8 ± 1.4 37.4 ± 1.4 37.4 ± 1.6 $65.2 \pm$	Rouge de Loum 57.2 76.6 34.1 39.0 167.3 58.1 $32.$ Banane Tigree 37 ± 2 74.3 ± 1.2 10.3 ± 1 45.7 ± 1.2 111.0 ± 6.7 59.8 ± 2.6 28 ± 0.2 Kar Ngou 43.6 ± 3 78.4 ± 1.9 25.0 ± 4.7 37.2 ± 1.3 107.0 ± 5.7 61.8 ± 1.7 30 ± 0.3 French Sombre 42.7 76.5 25.8 ± 4.7 37.2 ± 1.3 107.0 ± 5.7 61.8 ± 1.7 30 ± 0.3 Kelong Mekintu 56.6 77.7 31.3 29.7 1130.9 64.9 2.5 Red Yade 56.9 ± 1 76.5 ± 2.3^{10} 37.8 ± 0.5 $133.3 \pm 2.5.3$ 2.8 ± 3.9 2.6 ± 0.1 Red Yade 56.9 ± 1 76.2 ± 2^{40} 27.2 ± 5.9^{1} 36.6 ± 6.8^{40} 221.9 ± 83.2^{1} 64.8 ± 4.5^{16} 31.4 ± 0.4^{16} Baturd 56.4 ± 1.5 75.4 ± 1.3 33.4 ± 1.8 36.6 ± 6.8^{40} 221.9 ± 83.2^{4} 64.8 ± 4.5^{16} 31.4 ± 0.4^{16} Mouroukou no. 1 63.9 ± 2.5 $77.4 \pm 33.4 \pm 3.8$ 40.8 ± 0.8 296.7 ± 3.9 2.6 ± 0.1 Mouroukou no. 1 63.9 ± 2.5 75.8 ± 1.4 33.4 ± 1.4 292.2 ± 4.7 66.5 ± 2.4 31.4 ± 0.2 Mouroukou no. 1 63.9 ± 2.5 $77.4 \pm 33.4 \pm 3.8$ 40.8 ± 0.8 296.7 ± 3.9 56.2 ± 2.4 3.6 ± 0.3 Mouroukou no. 1 63.9 ± 2.5 $77.4 \pm 3.34 \pm 1.4$ 292.2 ± 4.7 66.5 ± 2.4 32.4 ± 0.2 Mouroukou no. 1 63.9 ± 2.5 $77.4 \pm 2.32 \pm 3.3$ 34.1 ± 1.4	Mbeta 1	53.4 ± 1.5	79.5 ± 1.9	36.2 ± 3.4	38.1 ± 3.2	169.4 ± 1.5	67.2 ± 1.2	2.8 ± 0.3	89.3 ± 0.3	64.7 ± 2	*******
Banne Tigre 37 ± 2 743 ± 12 103 ± 1 437 ± 12 1110 ± 67 598 ± 2.6 28 ± 0.2 862 ± 2.3 599 ± 2.2 Banne Tigre 37 ± 2 743 ± 12 103 ± 1 437 ± 1.3 1070 ± 5.7 618 ± 1.7 30 ± 0.3 882 ± 0.9 589 ± 2.2 599 ± 2.2 Kalong Meliuu 566 777 320 250 431 1380 64.8 ± 1.7 30 ± 0.3 883 ± 0.9 580 ± 0.1 Kolong Meliuu 566 777 330 257 61.8 ± 1.7 30 ± 0.3 887 62.2 Meli 51.7 77.4 31.4 44.3 93.4 580 2.8 ± 3.9 88.7 60.1 Kolong Meliuu 51.7 76.4 ± 3.3 33.3 ± 3.5 35.4 ± 3.3 33.3 ± 3.5 35.4 ± 3.3 33.3 ± 3.5 56.6 ± 6.8^3 21.9 ± 8.3^2 64.8 ± 4.5^8 31.1 ± 0.4^8 86.5 ± 2^2 60.3 Medi 55.7 75.4 ± 3.3 33.4 ± 3.8 40.8 ± 0.8 2967 ± 3.9 67.2 ± 3.9 34 ± 4.5^8 31.4 ± 0.2 86.5 ± 2^2 60.3 Mouroulou no.1 639 ± 2.5 762 ± 1.8 $27.4\pm 3.34\pm 3.8$ 40.8 ± 0.8 2967 ± 3.9 56.2 35.2 ± 3.5 56.2 55.2 ± 3.5 56.2	Banane Tigree 37 ± 2 74.3 ± 1.2 10.3 ± 1 45.7 ± 1.2 111.0 ± 6.7 59.8 ± 2.6 2.8 ± 0.2 Kar Ngou 43.6 ± 3 78.4 ± 1.9 25.0 ± 4.7 37.2 ± 1.3 107.0 ± 5.7 61.8 ± 1.7 3.0 ± 0.3 French Sombre 42.7 76.5 25.8 ± 4.3 37.2 ± 1.3 107.0 ± 5.7 61.8 ± 1.7 3.0 ± 0.3 Meki 51.7 77.4 31.4 4.3 93.4 58.0 2.5 Meki 51.7 77.4 31.4 4.3 93.4 58.0 2.8 Meki 51.7 77.4 31.4 4.3 93.4 58.0 2.8 Meki 51.7 76.2 ± 2.3^{10} 27.2 ± 5.9^{10} 27.3 ± 0.5 $13.3 \pm 3.5.3$ 64.8 ± 4.5^{16} 3.1 ± 0.4^{2} Mourouku no. 1 56.4 75.4 33.8 ± 3.5 37.4 ± 0.8 109.2 66.2 ± 2.3 3.4 ± 0.2 Mourouku no. 1 65.9 ± 2.5 76.2 ± 1.8 24.3 ± 4.1 37.4 ± 1.4 222.19 ± 83.2^{2} 64.8 ± 4.5^{16} 3.1 ± 0.4^{2} Mourouku no. 1 63.9 ± 2.5 76.2 ± 1.8 24.3 ± 4.1 37.4 ± 1.4 222.2 ± 4.7 66.5 ± 2.8 34 ± 0.2 Mourouku no. 1 63.9 ± 2.5 76.2 ± 1.8 24.3 ± 1.4 37.4 ± 1.4 222.2 ± 4.7 66.5 ± 2.4 23.4 ± 0.2 Mourouku no. 1 63.9 ± 2.5 76.2 ± 2.4 33.4 ± 0.2 36.1 ± 1.1 56.2 ± 2.8 36.4 ± 0.2 Mourouku no. 1 53.9 ± 2.5 76.2 ± 2.4 23.5 ± 2.5 36.1	Rouge de Loum	57.2	76.6	34.1	39.0	167.3	58.1	3.2	87.9	62.4	
Kar Ngou 43.6 ± 3 78.4 ± 19 25.0 ± 4.7 37.2 ± 1.3 107.0 ± 5.7 61.8 ± 1.7 3.0 ± 0.3 83.8 ± 0.9 58.0 ± 0.1 Kenerk Sombre 42.7 75.5 25.8 43.1 138.0 64.9 25.0 61.1 60.1 Kenerk Sombre 31.7 77.7 33.0 29.7 130.9 64.9 2.8 85.7 60.3 Kelong Mekinu 56.6 77.7 33.0 29.7 130.9 64.9 2.8 85.7 60.3 Meki 51.7 77.4 31.4 44.3 93.4 58.0 2.8 85.8 60.3 Meki 56.9 ± 1 76.2 ± 2^{16} 27.3 ± 5.9 36.6 ± 6.8^{16} 21.19 ± 83.2^{2} 64.8 ± 4.5^{16} 3.1 ± 0.4^{2} 60.3 ± 1.4^{4} Meti 56.4 76.2 ± 2^{16} 27.2 ± 5.9 36.6 ± 6.8^{16} 21.19 ± 83.2^{2} 64.8 ± 4.5^{16} 3.1 ± 0.4^{2} 66.3 ± 1.4^{4} Mouronkoun no. 1 63.9 ± 2.5 76.2 ± 1.8 $27.4 \pm 33.4 \pm 3.9$ 90.7 ± 1.3 56.4 ± 2.8 60.4 ± 1.7 Mouronkoun no. 1 63.9 ± 2.5 76.2 ± 1.8 27.3 ± 3.3 34.11 56.4 ± 2.8 56.3 ± 2.5 56.3 ± 2.5 Mouronkoun no. 1 63.9 ± 2.5 76.2 ± 1.8 27.3 ± 3.3 36.1 ± 1.11 57.4 ± 2.9 36.4 ± 1.7 56.4 ± 2.8 56.3 ± 1.2 Mouronkoun no. 1 63.9 ± 2.5 76.2 ± 1.8 27.3 ± 3.5 36.1 ± 1.11 57.9 ± 2.2 $37.0 \pm 8.8 \pm 1.5$ 56.3 ± 2.7 56.3 ± 2.7 <	Kar Ngou 436 ± 3 784 ± 1.9 25.0 ± 4.7 37.2 ± 1.3 107.0 ± 5.7 61.8 ± 1.7 3.0 ± 0.3 French Sombre $4.2.7$ 76.5 25.8 43.1 158.0 63.0 3.0 2.5 Kelong Mekintu 56.6 77.7 33.0 29.7 130.9 64.9 2.5 3.0 Meki 51.7 77.4 31.4 44.3 93.4 58.0 2.0 2.6 2.6 Meki 51.2 ± 12.1^3 76.2 ± 2^{16} 23.7 ± 0.5 33.2 ± 3.5 37.8 ± 0.5 123.3 ± 2.53 64.8 ± 4.5^{16} 3.1 ± 0.4^3 Red Yade 56.9 ± 1 76.4 75.4 ± 2.3 33.3 ± 3.5 37.8 ± 0.5 123.3 ± 2.53 66.8 ± 4.5^{16} 3.1 ± 0.4^3 Moutom $56.4 \times 75.4 \pm 2.4$ 33.4 ± 3.8 40.8 ± 0.8 292.2 ± 47 66.5 ± 2.8 3.4 ± 0.2 Moutomoutou no. 1 63.9 ± 2.5 $76.4 \times 3.34 \pm 1.4$ 37.4 ± 1.6 52.2 ± 4.7 66.5 ± 2.8 3.4 ± 0.2 Moutomoutou no. 1 63.9 ± 2.5 76.2 ± 1.8 $77.4 \pm 3.34 \pm 1.6$ 37.4 ± 1.6 66.5 ± 2.8 3.4 ± 0.2 Moutomoutou no. 1 63.9 ± 2.5 76.2 ± 2.4 33.4 ± 1.6 66.5 ± 2.8 3.4 ± 0.2 Moutomoutou no. 1 63.9 ± 2.6 75.4 ± 2.4 29.7 ± 2.4 29.7 ± 0.2 Moutomoutou no. 1 63.9 ± 2.6 75.2 ± 2.4 29.7 ± 0.2 Moutomoutou no. 1 63.9 ± 0.7 75.6 ± 2.4 $29.2 \pm $	Banane Tigree	37 ± 2	74.3 ± 1.2	10.3 ± 1	43.7 ± 1.2	111.0 ± 6.7	59.8 ± 2.6	2.8 ± 0.2	86.2 ± 2.3	59.9 ± 2.2	
French Sombre 4.7 76.5 25.8 43.1 158.0 63.0 3.0 86.7 00.1 Kelong Mekintu 5.6 77.7 33.0 29.7 130.9 64.9 2.5 88.7 02.1 Kelong Mekintu 5.6 77.7 31.4 4.43 93.4 53.2 25.8 8.87 00.1 Meki $5.1.7$ 7.74 33.0 29.7 130.9 64.9 2.5 88.7 00.1 Meki $5.6.9 \pm 1$ 76.2 ± 2^{46} 27.2 ± 5.9^{4} 36.6 ± 6.8^{4b} 221.9 ± 83.2^{2} 64.8 ± 4.5^{16} 3.1 ± 0.4^{2} 86.5 ± 2^{2} 60.8 ± 1.4^{4} Mounoukun n.1 $5.6.4 \pm 7.54 \pm 3.3$ 4.19 190.2 $6.5.2 \pm 3.9$ 2.5 ± 1.6 70.4 ± 1.2 75.2 ± 2.9^{2} 36.6 ± 2.8^{2} 60.8 ± 1.4^{4} Mounoukun n.1 $5.6.4 \pm 7.54 \pm 3.3$ 4.19 190.2 $6.5.2 \pm 3.9$ 5.7 ± 2.9 87.0 ± 1.3 60.8 ± 1.4^{4} Mounoukun n.1 5.3 ± 1.5 75.8 ± 1.4 3.34 ± 1.8 $3.94.11$ $22.9 \pm 8.3.7$ 66.5 ± 2.8 3.6 ± 0.1 86.5 ± 2.9 60.6 ± 2.7 Mounoukun n.1 5.3 ± 2.1 $77.4 \pm 3.3.4 \pm 3.3$ $3.91.11$ 27.5 ± 2.8 3.61 ± 1.17 $5.6.2 \pm 2.4$ 2.32 ± 0.4 $8.6.5 \pm 1.5$ $5.6.5 \pm 2.3$ 5	French Sombre 4.7 76.5 25.8 43.1 158.0 63.0 3.0 3.0 Kelong Mekintu 56.6 77.7 33.0 29.7 130.9 64.9 2.5 Meki 51.7 77.4 31.4 44.3 93.4 58.0 2.5 2.5 Meki 51.7 77.4 31.4 44.3 93.4 58.0 2.6 2.6 Meki 56.9 ± 1 76.6 ± 2.3 33.3 ± 3.5 37.8 ± 0.5 123.3 ± 25.3 64.8 ± 4.5^{16} 31.1 ± 0.4^{3} PC-Hom 51.1 ± 12.1^{3} 76.2 ± 2^{16} $2.7.2 \pm 5.9^{3}$ 36.6 ± 6.8^{10} 22.9 65.2 ± 3.9 2.6 ± 0.1 Baturd 56.4 75.4 ± 3.3 41.9 190.2 65.2 ± 3.9 $54.4 \cdot 3.1 \pm 0.4^{3}$ $3/4$ Nain 55.4 ± 1.5 75.8 ± 1.4 33.4 ± 3.8 40.8 ± 0.8 256.7 ± 3.9 34.6 ± 0.3 $3/4$ Noncoulou no. 1 63.9 ± 2.5 76.2 ± 1.8 37.4 ± 1.4 292.22 ± 4.7 66.5 ± 2.8 36.4 ± 0.3 $76-17$ 58 27.4 ± 1.4 37.8 ± 0.1 37.8 ± 0.1 37.8 ± 0.1 37.8 ± 0.2 Niangfelo 25.3 ± 0.9 80.9 ± 0.7 17.5 ± 2.2 23.5 ± 1.1 107.0 ± 11.7 54.6 ± 1.6 32.4 ± 0.4 $76-17$ 58 36.1 ± 1.1 275.2 ± 2.4 23.9 ± 0.2 37.6 ± 2.4 29.9 ± 0.2 31.4 ± 0.2 Noto Ebanga 55.2 ± 5.1 107.6 ± 1.6 75.2 ± 2.4 23.2 ± 0.4 42.5 ± 5.1 107.6 ± 0.2 <	Kar Ngou	43.6 ± 3	78.4 ± 1.9	25.0 土 4.7	37.2 ± 1.3	107.0 ± 5.7	61.8 ± 1.7	3.0 ± 0.3	83.8 ± 0.9	58.0 ± 0.1	
Kelong Mekint56.677.733.029.7130.964.92.588.76.22Meki51.777.431.444.393.458.02.858.860.3Meki51.777.431.444.353.453.253.453.264.8 1.74° 60.3Red Yade56.411.776.421.375.433.333.335.65.65.831.40.460.3Baturd56.475.433.841.9190.265.22.90.488.360.4Start55.475.811.875.433.433.4190.265.22.90.711.4Monroukou no. 156.475.433.433.4190.256.22.957.25.951.41.4Monroukou no. 163.92.575.211.756.52.957.25.960.41.4Monroukou no. 163.92.575.411.756.52.957.25.953.453.3Monroukou no. 163.92.575.52.52.511.756.52.29.753.453.453.4Monroukou no. 163.92.575.52.52.511.756.52.29.751.453.453.453.4Monroukou no. 163.92.72.33.40.256.22.957.42.953.453.453.453.45	Kelong Mekintu566 77.7 33.0 29.7 130.9 64.9 2.5 Meki 51.7 77.4 31.4 44.3 93.4 58.0 2.8 2.8 Meki 51.7 77.4 31.4 44.3 93.4 58.0 2.8 2.8 Red Yade 56.9 ± 1 76.6 ± 2.3 33.3 ± 3.5 37.8 ± 0.5 123.3 ± 25.3 64.8 ± 4.5^{hc} 31.1 ± 0.4^{a} Pc.Horn 51.2 ± 12.1^{a} 76.2 ± 2^{ab} 27.2 ± 5.9^{a} 36.6 ± 6.8^{ab} 21.9 ± 83.2^{a} 64.8 ± 4.5^{hc} 31.1 ± 0.4^{a} Batard 56.4 75.4 33.8 ± 3.8 41.9 190.2 65.2 2.9 3.4 ± 0.2 Mouroukou no. 1 63.9 ± 2.5 76.2 ± 1.8 24.3 ± 4.1 37.4 ± 1.4 292.2 ± 47 66.5 ± 2.8 3.6 ± 0.3 Mouroukou no. 1 63.9 ± 2.5 76.2 ± 1.8 24.3 ± 4.1 37.4 ± 1.4 292.2 ± 47 66.5 ± 2.8 3.6 ± 0.3 Mouroukou no. 1 63.9 ± 2.5 76.2 ± 1.8 24.5 ± 1.1 37.4 ± 1.4 292.2 ± 47 66.5 ± 2.28 3.6 ± 0.3 Moto Ebanga 55.2 ± 5.1 77.4 32.0 37.8 ± 1.1 66.0 3.3 56.4 2.9 ± 0.2 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 36.1 ± 1.1 225.9 ± 56.1 67.2 ± 2.4 2.9 ± 0.2 Moto Ebanga 55.2 ± 3.5 75.6 ± 2.4 23.2 ± 3.5 36.1 ± 1.6 23.2 ± 0.4 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23	French Sombre	42.7	76.5	25.8	43.1	158.0	63.0	3.0	86.7	60.1	
Meki $S_{1.7}$ 774 314 44.3 93.4 58.0 2.8 $8.5.8$ 60.3 Red Yade 56.9 ± 1 76.6 ± 2.3 33.3 ± 3.5 37.8 ± 0.5 $12.33 \pm 3.5.3$ 37.8 ± 0.5 60.3 ± 1.4^4 Red Yade 56.9 ± 1 76.5 ± 2.3 $33.3 \pm 3.5.3$ 37.8 ± 0.5 64.8 ± 4.5^{16} 3.1 ± 0.4^{2} 88.5 ± 0.7 60.3 ± 1.4^4 Batard 56.4 75.4 33.8 41.9 19.02 $65.2 \pm 3.8.5 \pm 3.6.6 \pm 6.8^{10}$ 22.19 ± 83.2^{2} 66.8 ± 2.2^{2} 60.8 ± 1.4^4 Batard 55.4 75.2 ± 1.8 33.4 ± 3.8 40.8 ± 20.8 96.7 ± 3.9 56.5 ± 2.8 36.6 ± 2^{2} 60.8 ± 1.4^4 Batard 55 ± 1.5 75.8 ± 1.4 33.4 ± 3.8 40.8 ± 0.8 99.7 ± 3.9 34.6 ± 0.2 88.5 ± 0.7 60.8 ± 1.4^4 Mburukou no.1 63.9 ± 2.5 77.4 32.4 ± 3.8 40.8 ± 0.8 59.7 ± 3.9 34.6 ± 0.2 88.7 ± 1.5 60.8 ± 2.2 Mburukou no.1 63.9 ± 2.5 77.4 32.4 ± 3.8 40.8 ± 0.8 59.7 ± 3.2 50.5 ± 1.3 53.6 ± 0.2 88.3 ± 1.5 $76-17$ 58 77.4 32.0 37.8 ± 1.1 299.2 ± 4.7 66.0 3.3 ± 0.4 88.8 ± 1.5 60.6 ± 1.7 Mourukou no.1 63.9 ± 2.5 79.7 ± 2 23.5 ± 3.3 $34.1.1$ 25.9 ± 2.6 60.8 ± 2.2 60.8 ± 2.2 More Ebanga 55.2 ± 3.9 70.7 30.9 ± 1.6 52.5 ± 2.3 $50.1.1$ $50.7 \pm 2.3 \pm 2.0.4$	Meli 51.7 77.4 31.4 44.3 93.4 58.0 2.8 2.6 ± 0.1 Red Yade 56.9 ± 1 76.6 ± 2.3 33.3 ± 3.5 37.8 ± 0.5 123.3 ± 25.3 62.8 ± 3.9 2.6 ± 0.1 PC-Horn 51.2 ± 12.1^4 76.2 ± 2^{2b} 27.2 ± 5.9^4 36.6 ± 6.8^{ab} 221.9 ± 83.2^a 64.8 ± 4.5^{bc} 3.1 ± 0.4^a Batard 56.4 75.4 33.8 41.9 190.2 65.2 ± 3.9 2.6 ± 0.1 $3/4$ Nain $55.4 + 75.4$ 33.8 41.9 190.2 65.2 ± 3.9 3.4 ± 0.2 Mbouroukou no. 1 63.9 ± 2.5 76.2 ± 1.8 24.3 ± 4.1 37.4 ± 1.4 292.2 ± 47 66.5 ± 2.8 3.6 ± 0.3 $76-17$ 58 77.4 32.0 37.8 40.8 ± 0.8 $34.1.1$ 57.2 ± 3.9 3.4 ± 0.2 Mbouroukou no. 1 63.9 ± 2.5 76.2 ± 1.8 24.3 ± 4.1 37.4 ± 1.4 292.2 ± 4.7 66.0 3.3 ± 0.4 Samagelo 25.3 ± 0.9 80.9 ± 0.7 17.5 ± 2.2 20.5 ± 1 107.0 ± 11.7 54.6 ± 1.6 3.2 ± 0.4 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 36.1 ± 1.1 225.9 ± 56.1 67.2 ± 2.4 2.9 ± 0.2 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 36.1 ± 1.1 225.9 ± 56.1 67.2 ± 2.4 2.9 ± 0.2 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 36.1 ± 1.6 129.3 ± 1.6 $19.5.5$ 53.2 ± 2.4 29.2 ± 0.4 H	Kelong Mekintu	56.6	7.7.7	33.0	29.7	130.9	64.9	2.5	88.7	62.2	
Red Yade 569 ± 1 76.6 ± 2.3 333 ± 3.5 378 ± 0.5 1233 ± 25.3 62.8 ± 3.9 2.6 ± 0.1 88.5 ± 0.7 61.7 ± 1 De CHom 51.2 ± 1.1^4 76.2 ± 2^{16} 27.2 ± 5.9^4 36.6 ± 6.8^{16} 21.19 ± 83.2^4 64.8 ± 4.5^{16} 3.1 ± 0.4^4 86.6 ± 2^4 60.8 ± 1.4^4 Baturd 56.4 75.4 33.8 41.9 190.2 65.2 2.9 88.3 ± 0.7 60.4 Mouroniou no. 1 63.9 ± 2.5 76.2 ± 1.8 3.4 ± 3.3 40.8 ± 0.8 29.07 ± 1.3 66.5 ± 2.8 3.4 ± 0.2 87.0 ± 1.2 60.8 ± 1.4^4 Mouroniou no. 1 63.9 ± 2.5 76.2 ± 1.8 3.4 ± 3.4 3.74 ± 1.4 292.2 ± 47 66.5 ± 2.8 3.6 ± 0.3 89.7 ± 1.2 60.6 ± 2.2 Mouroniou no. 1 63.9 ± 2.5 76.2 ± 1.8 3.4 ± 0.2 87.0 ± 1.6 3.2 ± 0.3 89.7 ± 1.5 Mouroniou no. 1 63.9 ± 2.5 76.2 ± 1.8 3.24 ± 0.2 87.6 ± 1.6 3.2 ± 0.2 87.6 ± 1.3 Monto Binga 5.3 ± 5.1 77.4 ± 32.2 20.5 ± 1 107.0 ± 11.7 54.6 ± 1.6 3.2 ± 0.2 84.8 ± 1.5 60.6 ± 1.7 Moto Ebanga 5.2 ± 5.1 77.7 ± 2.2 23.5 ± 3.3 36.1 ± 1.1 23.5 ± 5.4 60.6 ± 1.2 63.9 ± 1.6 60.5 ± 2.2 Moto Ebanga 53.2 ± 3.0 75.6 ± 2.4 23.2 ± 3.5 56.1 67.2 ± 2.4 2.9 ± 0.2 84.8 ± 1.7 60.6 ± 1.7 Moto Ebanga 53.2 ± 3.5 75.6 ± 2.4 23.2 ± 0.2 <td>Red Yade$56.9 \pm 1$$76.6 \pm 2.3$$33.3 \pm 3.5$$37.8 \pm 0.5$$12.3.3 \pm 25.3$$6.8 \pm 3.3.9$$2.6 \pm 0.1$PC-Horn$51.2 \pm 12.1^3$$76.2 \pm 2^{26}$$27.2 \pm 5.9^3$$36.6 \pm 6.8^{4b}$$221.9 \pm 83.2^3$$64.8 \pm 4.5^{bc}$$3.1 \pm 0.4^3$Batard$56.4$$75.4$$33.8$$41.9$$190.2$$65.2$$2.9$$3.4 \pm 0.2$Mbouroukou no. 1$53.9 \pm 1.5$$75.8 \pm 1.4$$33.4 \pm 3.8$$40.8 \pm 0.8$$296.7 \pm 3.9$$67.2 \pm 3.9$$3.4 \pm 0.2$Mbouroukou no. 1$63.9 \pm 2.5$$76.2 \pm 1.8$$24.3 \pm 4.1$$37.4 \pm 1.4$$292.2 \pm 47$$66.5 \pm 2.8$$3.4 \pm 0.2$Mbouroukou no. 1$63.9 \pm 2.5$$76.2 \pm 1.8$$24.3 \pm 4.1$$37.4 \pm 1.4$$292.2 \pm 47$$66.5 \pm 2.8$$3.6 \pm 0.3$Niangafelo$25.3 \pm 0.9$$80.9 \pm 0.7$$17.5 \pm 2.2$$20.5 \pm 1.1$$107.0 \pm 11.7$$54.6 \pm 1.6$$3.2 \pm 0.4$Moto Ebanga$55.2 \pm 3.9$$75.6 \pm 2.4$$23.2 \pm 3.5$$36.1 \pm 1.1$$225.9 \pm 56.1$$67.2 \pm 2.4$$2.9 \pm 0.2$Moto Ebanga$55.2 \pm 3.9$$76.809$$29.5$$33.1 \pm 1.6$$129.3 \pm 1.2$$66.0$$3.2 \pm 0.4$Hybrid$53.3$$76.809$$29.5$$33.1 \pm 1.6$$1292.5$$62.7 \pm 2.4$$2.9 \pm 0.2$Hybrid$53.3 \pm 0.4$$75.6 \pm 2.4$$23.2 \pm 3.5$$56.1$$67.7 \pm 2.4$$2.9 \pm 0.2$Hybrid$55.2 \pm 3.3$$36.1 \pm 1.1$$225.9 \pm 56.1$$67.2 \pm 2.4$$2.9 \pm 0.2$Hybrid$53.3 \pm 0.4$<t< td=""><td>Meki</td><td>S1.7</td><td>77.4</td><td>31.4</td><td>44.3</td><td>93.4</td><td>58.0</td><td>2.8</td><td>85.8</td><td>60.3</td><td></td></t<></td>	Red Yade 56.9 ± 1 76.6 ± 2.3 33.3 ± 3.5 37.8 ± 0.5 $12.3.3 \pm 25.3$ $6.8 \pm 3.3.9$ 2.6 ± 0.1 PC-Horn 51.2 ± 12.1^3 76.2 ± 2^{26} 27.2 ± 5.9^3 36.6 ± 6.8^{4b} 221.9 ± 83.2^3 64.8 ± 4.5^{bc} 3.1 ± 0.4^3 Batard 56.4 75.4 33.8 41.9 190.2 65.2 2.9 3.4 ± 0.2 Mbouroukou no. 1 53.9 ± 1.5 75.8 ± 1.4 33.4 ± 3.8 40.8 ± 0.8 296.7 ± 3.9 67.2 ± 3.9 3.4 ± 0.2 Mbouroukou no. 1 63.9 ± 2.5 76.2 ± 1.8 24.3 ± 4.1 37.4 ± 1.4 292.2 ± 47 66.5 ± 2.8 3.4 ± 0.2 Mbouroukou no. 1 63.9 ± 2.5 76.2 ± 1.8 24.3 ± 4.1 37.4 ± 1.4 292.2 ± 47 66.5 ± 2.8 3.6 ± 0.3 Niangafelo 25.3 ± 0.9 80.9 ± 0.7 17.5 ± 2.2 20.5 ± 1.1 107.0 ± 11.7 54.6 ± 1.6 3.2 ± 0.4 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 36.1 ± 1.1 225.9 ± 56.1 67.2 ± 2.4 2.9 ± 0.2 Moto Ebanga 55.2 ± 3.9 76.809 29.5 33.1 ± 1.6 129.3 ± 1.2 66.0 3.2 ± 0.4 Hybrid 53.3 76.809 29.5 33.1 ± 1.6 1292.5 62.7 ± 2.4 2.9 ± 0.2 Hybrid 53.3 ± 0.4 75.6 ± 2.4 23.2 ± 3.5 56.1 67.7 ± 2.4 2.9 ± 0.2 Hybrid 55.2 ± 3.3 36.1 ± 1.1 225.9 ± 56.1 67.2 ± 2.4 2.9 ± 0.2 Hybrid 53.3 ± 0.4 <t< td=""><td>Meki</td><td>S1.7</td><td>77.4</td><td>31.4</td><td>44.3</td><td>93.4</td><td>58.0</td><td>2.8</td><td>85.8</td><td>60.3</td><td></td></t<>	Meki	S1.7	77.4	31.4	44.3	93.4	58.0	2.8	85.8	60.3	
PC.Hom $S12 \pm 12.1^a$ 762 ± 2^{3b} 27.2 ± 5.9^a 36.6 ± 6.8^{ab} 221.9 ± 83.2^a 64.8 ± 4.5^{1c} 3.1 ± 0.4^a 86.6 ± 2^a 60.8 ± 1.4^a Batard 56.4 75.4 33.8 41.9 190.2 65.2 2.9 88.3 60.4 $3/4$ Nain 55 ± 1.5 75.8 ± 1.4 33.4 ± 3.8 40.8 ± 0.8 290.7 ± 1.2 61.3 ± 0.7 Mbouroukou no. 1 63.9 ± 2.5 76.2 ± 1.8 24.3 ± 4.1 37.4 ± 1.4 37.4 ± 1.4 292.2 ± 4.7 66.5 ± 2.8 3.6 ± 0.3 90.7 ± 1.3 60.4 Mbouroukou no. 1 63.9 ± 2.5 76.2 ± 1.8 24.3 ± 4.1 37.4 ± 1.4 37.4 ± 1.4 292.2 ± 4.7 66.5 ± 2.8 3.6 ± 0.3 90.7 ± 1.3 60.4 ± 1.5 Mbouroukou no. 1 63.9 ± 2.5 76.9 ± 0.7 37.8 ± 34.1 37.4 ± 1.4 37.4 ± 1.4 292.2 ± 4.7 66.5 ± 2.8 3.6 ± 0.3 87.6 ± 1.5 69.6 ± 1.7 Ningafelo 25.3 ± 5.1 797 ± 2 23.5 ± 5.3 36.1 ± 1.1 22.5 ± 2.4 2.9 ± 0.2 84.9 ± 1.5 60.6 ± 1.7 Mote Banga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 36.1 ± 1.6 22.3 ± 0.2 88.9 ± 1.6 60.6 ± 1.7 Mote Banga 55.2 ± 3.9 75.6 ± 2.4 22.3 ± 1.6 72.5 ± 2.3 23.2 ± 0.2 84.9 ± 1.6 60.6 ± 1.7 Mote Banga 55.2 ± 3.9 75.6 ± 2.4 22.3 ± 0.2 88.9 ± 1.6 60.5 ± 1.6 59.0 ± 0.7 Mote Banga 55.2 ± 3.5 75.6 ± 2.4	PC-Horn 51.2 ± 12.1^3 76.2 ± 2^{26} 27.2 ± 5.9^3 36.6 ± 6.8^{ab} 221.9 ± 83.2^3 64.8 ± 4.5^{bc} 3.1 ± 0.4^3 Batard 56.4 75.4 33.8 41.9 190.2 65.2 2.9 $3/4$ Nain 55 ± 1.5 75.8 ± 1.4 33.4 ± 3.8 40.8 ± 0.8 296.7 ± 39 67.2 ± 3.9 3.4 ± 0.2 Mbouroukou no. 1 63.9 ± 2.5 76.2 ± 1.8 24.3 ± 4.1 37.4 ± 1.4 292.2 ± 47 66.5 ± 2.8 3.6 ± 0.3 Mbouroukou no. 1 63.9 ± 2.5 77.4 32.0 37.8 $34.1.1$ 66.0 3.3 Niangafelo 25.3 ± 0.9 80.9 ± 0.7 17.5 ± 2.2 20.5 ± 1 107.0 ± 11.7 54.6 ± 1.6 3.2 ± 0.4 Niangafelo 25.3 ± 0.9 80.9 ± 0.7 17.5 ± 2.2 20.5 ± 1 107.0 ± 11.7 54.6 ± 1.6 3.2 ± 0.4 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 36.1 ± 1.1 225.9 ± 56.1 67.2 ± 2.4 2.9 ± 0.2 Moto Ebanga 55.2 ± 3.9 76.809 29.8 40.2 129.3 ± 1.2 66.7 3.2 ± 0.4 Hybrid 53.3 76.809 29.8 40.2 129.3 ± 1.2 66.7 ± 2.4 2.9 ± 0.2 Hybrid 53.3 ± 0.4 56.1 129.3 ± 1.6 63.7 ± 2.4 2.9 ± 0.2 Initism 53.3 76.809 29.8 40.2 $129.2.9 \pm 56.1$ 67.7 ± 2.4 2.9 ± 0.2 Hybrid 53.3 56.1 ± 1.6 $129.2.5 \pm 56.1$ 67.2 ± 2.4 $2.9 \pm$	Red Yade	56.9 ± 1	76.6 ± 2.3	33.3 ± 3.5	37.8 ± 0.5	123.3 ± 25.3	62.8 ± 3.9	2.6 ± 0.1	88.5 ± 0.7	61.7 ± 1	
Batard56475433.841.9190.265.22.988.300.4 $3/4$ Nain 55 ± 1.5 758 ± 1.4 33.4 ± 3.8 40.8 ± 0.8 296.7 ± 39 67.2 ± 3.9 34 ± 0.2 88.3 00.7 ± 1.2 01.3 ± 0.7 $3/4$ Nain 55 ± 1.5 758 ± 1.4 33.4 ± 3.8 40.8 ± 0.8 296.7 ± 3.9 57.2 ± 3.9 34 ± 0.2 87.0 ± 1.2 61.3 ± 0.7 $76-17$ 58 ± 7.7 32.0 37.8 $34.1.1$ 292.2 ± 4.7 66.5 ± 2.8 36 ± 0.3 90.7 ± 1.3 63.8 ± 1.5 $76-17$ 58 77.4 32.0 37.8 $34.1.1$ $59.2.2 \pm 4.7$ 66.0 3.3 87.0 ± 1.2 60.6 ± 2.2 Niangelo 25.3 ± 0.9 80.9 ± 0.7 17.5 ± 2.2 20.5 ± 1.1 $107.0 \pm 1.1.7$ 54.6 ± 1.6 3.2 ± 0.4 84.8 ± 1.5 60.6 ± 2.2 Niangelo 25.3 ± 0.9 80.9 ± 0.7 17.5 ± 2.2 23.5 ± 5.3 36.1 ± 1.1 22.59 ± 56.1 67.2 ± 2.4 2.9 ± 0.2 84.9 ± 1 60.6 ± 1.7 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 38.1 ± 1.6 129.3 ± 1.6 53.2 ± 0.2 85.5 ± 0.8 59.0 ± 0.7 Hybrid 53.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 51.2 23.8 ± 1.6 53.2 ± 0.8 59.0 ± 0.7 Hybrid 53.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 51.2 53.8 ± 1.6 53.2 ± 0.8 59.2 ± 0.8 Hybrid 53.2 ± 0.7 50.2 51.2 ± 0.7 50.2 ± 0	Batard 56.4 75.4 33.8 41.9 190.2 65.2 2.9 $3/4$ Nain 55 ± 1.5 75.8 ± 1.4 33.4 ± 3.8 40.8 ± 0.8 296.7 ± 39 67.2 ± 3.9 3.4 ± 0.2 Mbouroukou no. 1 63.9 ± 2.5 76.2 ± 1.8 24.3 ± 4.1 37.4 ± 1.4 292.2 ± 4.7 66.5 ± 2.8 3.6 ± 0.3 $76-17$ 58 77.4 32.0 37.8 $34.1.1$ 66.0 3.3 3.6 ± 0.3 Niangafelo 25.3 ± 0.9 80.9 ± 0.7 175 ± 2.2 20.5 ± 1 107.0 ± 11.7 54.6 ± 1.6 3.2 ± 0.4 Sang 42.5 ± 5.1 79.7 ± 2 23.5 ± 5.3 36.1 ± 1.1 225.9 ± 56.1 65.2 ± 2.4 29 ± 0.2 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 38.1 ± 1.6 129.3 ± 1.2 68.9 ± 1.6 2.3 ± 0.2 Initism 53.3 76.809 29.8 40.2 129.3 ± 1.2 68.9 ± 1.6 2.3 ± 0.2 Hybrid 53.3 76.809 29.8 40.2 129.3 ± 1.2 68.9 ± 1.6 2.3 ± 0.2 Hybrid 53.3 ± 0.4 76.809 29.8 40.2 192.5 62.7 2.3 ± 0.2 Hybrid 53.3 ± 0.4 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 <td< td=""><td>PC-Horn</td><td>51.2 ± 12.1^{a}</td><td>76.2 ± 2^{ab}</td><td>27.2 ± 5.9^{a}</td><td>36.6 ± 6.8^{ab}</td><td>221.9 ± 83.2^{a}</td><td>64.8 ± 4.5^{bc}</td><td>3.1 ± 0.4^{a}</td><td>86.6 ± 2^{a}</td><td>$60.8 \pm 1.4^{\circ}$</td><td></td></td<>	PC-Horn	51.2 ± 12.1^{a}	76.2 ± 2^{ab}	27.2 ± 5.9^{a}	36.6 ± 6.8^{ab}	221.9 ± 83.2^{a}	64.8 ± 4.5 ^{bc}	3.1 ± 0.4^{a}	86.6 ± 2^{a}	$60.8 \pm 1.4^{\circ}$	
$3/4$ Nain 55 ± 1.5 75.8 ± 1.4 33.4 ± 3.8 40.8 ± 0.8 296.7 ± 39 67.2 ± 3.9 3.4 ± 0.2 87.0 ± 1.2 61.3 ± 0.7 $76-17$ 58 77.4 23.2 ± 4.1 37.4 ± 1.4 292.2 ± 4.7 66.5 ± 2.8 36 ± 0.3 90.7 ± 1.3 63.3 ± 1.5 $76-17$ 58 77.4 32.0 37.8 341.1 66.0 3.3 85.2 59.3 63.3 ± 1.5 Niangfelo 25.3 ± 0.9 80.9 ± 0.7 17.5 ± 2.2 20.5 ± 1 107.0 ± 11.7 54.6 ± 1.6 3.2 ± 0.4 84.8 ± 1.5 60.6 ± 2.2 Sang 42.5 ± 5.1 79.7 ± 2 23.5 ± 5.3 36.1 ± 1.1 225.9 ± 56.1 67.2 ± 2.4 2.9 ± 0.2 84.9 ± 1 60.6 ± 1.7 Essang 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 38.1 ± 1.6 129.3 ± 1.2 60.6 2.3 ± 0.2 84.9 ± 1 60.6 ± 1.7 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 38.1 ± 1.6 129.3 ± 1.2 60.7 3.1 ± 0.7 86.3 60.5 ± 1.7 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 38.1 ± 1.6 129.2 68.9 ± 1.6 2.3 ± 0.2 85.5 ± 0.8 60.5 ± 1.7 Moto Ebanga 55.2 ± 3.9 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 86.3 60.5 69.3 ± 1.4 Hybrid 56.8 50.3 ± 0.7 30.2 88.5 ± 0.7 89.3 ± 1.6 69.3 ± 1.4 69.3 ± 1.6 <tr <tr="">F 568$50.3$</tr>	$3/4$ Nain 55 ± 1.5 75.8 ± 1.4 33.4 ± 3.8 40.8 ± 0.8 296.7 ± 39 67.2 ± 3.9 3.4 ± 0.2 Mbouroukou no. 1 63.9 ± 2.5 76.2 ± 1.8 24.3 ± 4.1 37.4 ± 1.4 292.2 ± 4.7 66.5 ± 2.8 3.6 ± 0.3 $76-17$ 58 77.4 32.0 37.8 $34.1.1$ 66.0 3.3 Niangafelo 25.3 ± 0.9 80.9 ± 0.7 17.5 ± 2.2 20.5 ± 1 107.0 ± 11.7 54.6 ± 1.6 3.2 ± 0.4 Stand 42.5 ± 5.1 79.7 ± 2 23.5 ± 5.3 36.1 ± 1.1 225.9 ± 56.1 67.2 ± 2.4 2.9 ± 0.2 Mote Banga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 38.1 ± 1.6 129.3 ± 1.2 68.9 ± 1.6 2.3 ± 0.2 Initism 53.3 76.809 29.8 40.2 192.3 ± 1.2 68.9 ± 1.6 2.3 ± 0.2 Hybrid 53.3 ± 0.4 76.809 29.8 40.2 192.3 ± 1.2 68.9 ± 1.6 2.3 ± 0.2 Hybrid 53.3 ± 0.4 76.809 29.8 40.2 192.5 62.7 3.1 ± 0.5 Hybrid 53.3 ± 0.4 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8	Batard	56.4	7S.4	33.8	41.9	190.2	65.2	2.9	88.3	60.4	
Mbouroukou no. 1 63.9 ± 2.5 76.2 ± 1.8 24.3 ± 4.1 37.4 ± 1.4 292.2 ± 4.7 66.5 ± 2.8 3.6 ± 0.3 90.7 ± 1.3 63.8 ± 1.5 $76-17$ 58 77.4 32.0 37.8 341.1 66.0 3.3 85.2 59.8 $76-17$ 58 77.4 32.0 37.8 341.1 66.0 3.3 85.2 59.8 Niangafelo 25.3 ± 0.9 80.9 ± 0.7 17.5 ± 2.2 20.5 ± 1 107.0 ± 11.7 54.6 ± 1.6 3.2 ± 0.4 84.8 ± 1.5 60.6 ± 2.7 Essang 42.5 ± 5.1 79.7 ± 2 23.5 ± 5.3 36.1 ± 1.1 225.9 ± 56.1 67.2 ± 2.4 2.9 ± 0.2 84.9 ± 1 60.6 ± 1.7 Intism 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 38.1 ± 1.6 1293.3 ± 12 68.9 ± 1.6 2.3 ± 0.2 84.9 ± 1 60.5 ± 0.7 Intism 53.3 76.809 29.8 40.2 1293.3 ± 12 62.7 3.1 ± 0.2 85.5 ± 0.8 60.5 ± 1.7 Hybrid 53.3 76.809 29.8 40.2 199.5 62.7 3.1 ± 0.5 86.3 ± 1.6 Hybrid 53.9 ± 0.4 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 88.8 ± 1.7 88.5 ± 0.5 69.3 ± 1.4 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 5.8 ± 0.3 88.1 ± 1 69.3 ± 1.8 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 88.8	Mbouroukou no. 1 639 ± 2.5 762 ± 1.8 24.3 ± 4.1 37.4 ± 1.4 292.2 ± 4.7 66.5 ± 2.8 3.6 ± 0.3 $76-17$ 58 77.4 32.0 37.8 341.1 66.0 3.3 $76-17$ 58 77.4 32.0 37.8 341.1 66.0 3.3 Niangafelo 25.3 ± 0.9 80.9 ± 0.7 17.5 ± 2.2 20.5 ± 1 107.0 ± 11.7 54.6 ± 1.6 3.2 ± 0.4 Essang 42.5 ± 5.1 79.7 ± 2 23.5 ± 5.3 36.1 ± 1.1 225.9 ± 56.1 67.2 ± 2.4 2.9 ± 0.2 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.3 ± 3.5 38.1 ± 1.6 129.3 ± 12 68.9 ± 1.6 2.3 ± 0.2 Ihitism 53.3 76.809 29.8 40.2 192.5 62.7 2.3 ± 0.2 Hybrid 53.9 ± 0.4 76.620 29.8 40.2 192.5 62.7 3.1 ± 0.5 F 568 53.9 ± 0.4 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 er Table I for the significance of the group names. FW: firsh weight. For each cultivar, the value is the mean of two (standard deviation not	3/4 Nain	55 ± 1.5	75.8 ± 1.4	33.4 ± 3.8	40.8 ± 0.8	296.7 ± 39	67.2 ± 3.9	3.4 ± 0.2	87.0 ± 1.2	61.3 ± 0.7	
$76-17$ 58 77.4 32.0 37.8 $34.1.1$ 66.0 3.3 85.2 59.8 Niangafelo 253 ± 0.9 809 ± 0.7 17.5 ± 2.2 205 ± 1 107.0 ± 11.7 54.6 ± 1.6 3.2 ± 0.4 84.8 ± 1.5 60.6 ± 2.2 Essang 42.5 ± 5.1 79.7 ± 2 23.5 ± 5.3 36.1 ± 1.1 225.9 ± 56.1 67.2 ± 2.4 2.9 ± 0.2 84.9 ± 1 60.6 ± 1.7 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.5 ± 3.5 38.1 ± 1.6 129.3 ± 1.2 68.9 ± 1.6 2.3 ± 0.2 84.9 ± 1 60.6 ± 1.7 Ihitism 53.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 38.1 ± 1.6 129.3 ± 1.2 68.9 ± 1.6 2.3 ± 0.2 86.5 ± 0.8 60.5 Ihitism 53.3 76.809 29.8 40.2 129.3 ± 1.2 62.7 3.1 ± 0.5 86.5 ± 0.8 60.5 Hybrid 53.3 ± 0.4 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 88.8 ± 1.7 2.8 ± 0.3 69.3 ± 1.4 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 2.8 ± 0.3 88.5 ± 0.5 69.3 ± 1.8 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 2.8 ± 0.3 88.5 ± 0.5 69.3 ± 1.8 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 2.8 ± 0.3 88.1 ± 1.6 69.3 ± 1.8 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8	$76-17$ 58 77.4 32.0 37.8 341.1 66.0 3.3 Niangafelo 25.3 ± 0.9 80.9 ± 0.7 17.5 ± 2.2 20.5 ± 1 107.0 ± 11.7 54.6 ± 1.6 3.2 ± 0.4 Essang 42.5 ± 5.1 79.7 ± 2 23.5 ± 5.3 36.1 ± 1.1 225.9 ± 56.1 67.2 ± 2.4 2.9 ± 0.2 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 38.1 ± 1.6 129.3 ± 12 68.9 ± 1.6 2.3 ± 0.2 Initism 53.3 76.809 29.8 40.2 192.5 62.7 2.3 ± 0.2 Hybrid 53.9 ± 0.4 76.809 29.8 40.2 192.5 62.7 3.1 ± 0.5 F ybrid 53.9 ± 0.4 76.4 ± 2.1 34.0 ± 2.5 35.1 ± 1.6 208.4 ± 26.3 51.1 ± 0.7 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 F able 1 for the significance of the group names. FW: firsh weight. For each cultivar, the value is the mean of two (standard deviation not	Mbouroukou no. 1	63.9 ± 2.5	76.2 ± 1.8	24.3 ± 4.1	37.4 ± 1.4	292.2 ± 47	66.5 ± 2.8	3.6 ± 0.3	90.7 ± 1.3	63.8 ± 1.5	
Niangafelo 253 ± 0.9 80.9 ± 0.7 17.5 ± 2.2 20.5 ± 1 107.0 ± 11.7 54.6 ± 1.6 3.2 ± 0.4 84.8 ± 1.5 60.6 ± 2.2 60.6 ± 1.7 Essang 42.5 ± 5.1 79.7 ± 2 23.5 ± 5.3 36.1 ± 1.1 225.9 ± 56.1 67.2 ± 2.4 2.9 ± 0.2 84.9 ± 1 60.6 ± 1.7 60.6 ± 1.7 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 38.1 ± 1.6 129.3 ± 12 68.9 ± 1.6 2.3 ± 0.2 85.6 ± 0.8 59.0 ± 0.7 Hybrid 53.3 76.809 29.8 40.2 192.5 62.7 3.1 6.3 ± 1.6 2.3 ± 0.2 86.5 ± 0.8 50.3 ± 0.7 60.5 1.7 53.9 ± 0.4 76 ± 2.1 34.0 ± 2.5 35.1 ± 1.6 1292.5 62.7 3.1 ± 0.5 86.3 ± 1.6 5.3 ± 0.2 86.5 ± 0.8 50.3 ± 1.4 $C 292$ 53.9 ± 0.4 76 ± 2.1 34.0 ± 2.5 35.1 ± 1.6 208.4 ± 26.3 61.3 ± 0.7 3.1 ± 0.5 88.5 ± 0.5 69.3 ± 1.4 $7.5 58$ 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 88.1 ± 1 69.3 ± 1.8 69.3 ± 1.8 7.56 7.51 1.6 reach cultivar, the value is the mean of two (standard deviation not shown) to three biological replicates, each in duplicate.	Niangafelo 253 ± 0.9 80.9 ± 0.7 17.5 ± 2.2 20.5 ± 1 107.0 ± 11.7 54.6 ± 1.6 3.2 ± 0.4 Essang 42.5 ± 5.1 79.7 ± 2 23.5 ± 5.3 36.1 ± 1.1 225.9 ± 56.1 67.2 ± 2.4 2.9 ± 0.2 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 38.1 ± 1.6 129.3 ± 12 68.9 ± 1.6 2.3 ± 0.2 Ihitism 53.3 76.809 29.8 40.2 192.5 62.7 63.9 ± 1.6 2.3 ± 0.2 Hybrid C 292 53.9 ± 0.4 76 ± 2.1 34.0 ± 2.5 35.1 ± 1.6 208.4 ± 26.3 61.3 ± 0.7 3.1 ± 0.5 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 = Table I for the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not	76-17	58	77.4	32.0	37.8	341.1	66.0	3.3	85.2	59.8	
Essand Essand 42.5 ± 5.1 79.7 ± 2 23.5 ± 5.3 36.1 ± 1.1 225.9 ± 56.1 67.2 ± 2.4 2.9 ± 0.2 84.9 ± 1 60.6 ± 1.7 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 38.1 ± 1.6 129.3 ± 12 68.9 ± 1.6 2.3 ± 0.2 84.9 ± 1 60.6 ± 0.7 Hybrid 53.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 38.1 ± 1.6 129.3 ± 12 68.9 ± 1.6 2.3 ± 0.2 85.6 ± 0.8 59.0 ± 0.7 Hybrid 53.3 76.809 29.8 40.2 192.5 62.7 3.1 86.3 60.5 Hybrid 53.9 ± 0.4 76 ± 2.1 34.0 ± 2.5 35.1 ± 1.6 208.4 ± 26.3 61.3 ± 0.7 3.1 ± 0.5 88.5 ± 0.5 69.3 ± 1.4 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 88.1 ± 1 69.3 ± 1.8 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 88.1 ± 1 69.3 ± 1.8 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 2.8 ± 0.3 88.1 ± 1 69.3 ± 1.8 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 88.1 ± 1 69.3 ± 1.8 F 568 50.3 ± 2.5 76.7 ± 0.7 80.9 89.1 ± 1 69.3 ± 1.8 F 568 50.5 69.3 88.1 ± 1 69.3 ± 1.8 F 568 50.5 69.3 50.5 <t< td=""><td>Essang$42.5 \pm 5.1$$79.7 \pm 2$$23.5 \pm 5.3$$36.1 \pm 1.1$$225.9 \pm 56.1$$67.2 \pm 2.4$$2.9 \pm 0.2$Moto Ebanga$55.2 \pm 3.9$$75.6 \pm 2.4$$23.2 \pm 3.5$$38.1 \pm 1.6$$129.3 \pm 12$$68.9 \pm 1.6$$2.3 \pm 0.2$Ihitism$53.3$$76.809$$29.8$$40.2$$192.5$$62.7$$3.1$Hybrid$53.9 \pm 0.4$$76 \pm 2.1$$34.0 \pm 2.5$$35.1 \pm 1.6$$192.5$$62.7$$3.1 \pm 0.5$E 232$53.9 \pm 0.4$$76 \pm 2.1$$34.0 \pm 2.5$$35.1 \pm 1.6$$208.4 \pm 26.3$$61.3 \pm 0.7$$3.1 \pm 0.5$F 568$50.3 \pm 2.5$$76.7 \pm 0.7$$30.0 \pm 0.8$$34.7 \pm 2.1$$114.2 \pm 15.1$$58.8 \pm 1.7$$2.8 \pm 0.3$te Table I for the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not</td><td>Niangafelo</td><td>25.3 ± 0.9</td><td>80.9 ± 0.7</td><td>17.5 ± 2.2</td><td>20.5 ± 1</td><td>107.0 ± 11.7</td><td>54.6 ± 1.6</td><td>3.2 ± 0.4</td><td>84.8 ± 1.5</td><td>60.6 ± 2.2</td><td></td></t<>	Essang 42.5 ± 5.1 79.7 ± 2 23.5 ± 5.3 36.1 ± 1.1 225.9 ± 56.1 67.2 ± 2.4 2.9 ± 0.2 Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 38.1 ± 1.6 129.3 ± 12 68.9 ± 1.6 2.3 ± 0.2 Ihitism 53.3 76.809 29.8 40.2 192.5 62.7 3.1 Hybrid 53.9 ± 0.4 76 ± 2.1 34.0 ± 2.5 35.1 ± 1.6 192.5 62.7 3.1 ± 0.5 E 232 53.9 ± 0.4 76 ± 2.1 34.0 ± 2.5 35.1 ± 1.6 208.4 ± 26.3 61.3 ± 0.7 3.1 ± 0.5 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 te Table I for the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not	Niangafelo	25.3 ± 0.9	80.9 ± 0.7	17.5 ± 2.2	20.5 ± 1	107.0 ± 11.7	54.6 ± 1.6	3.2 ± 0.4	84.8 ± 1.5	60.6 ± 2.2	
Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 38.1 ± 1.6 129.3 ± 1.2 68.9 ± 1.6 2.3 ± 0.2 85.6 ± 0.8 59.0 ± 0.7 Thitsm 53.3 76.809 29.8 40.2 192.5 62.7 3.1 86.3 60.5 Hybrid 53.9 ± 0.4 76 ± 2.1 34.0 ± 2.5 35.1 ± 1.6 208.4 ± 26.3 61.3 ± 0.7 3.1 ± 0.5 88.5 ± 0.5 69.3 ± 1.4 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 88.1 ± 1 69.3 ± 1.8 7568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 88.1 ± 1 69.3 ± 1.8 7568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 88.1 ± 1 69.3 ± 1.8 7568 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 89.3 ± 1.8 7568 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 2.8 ± 0.3 88.1 ± 1 69.3 ± 1.8 Fuble 1 for the significance of the group names. FW: firesh weight. For each cultivar, the value is the mean of two (standard deviation not shown) to three biological replicates, each in duplicate.	Moto Ebanga 55.2 ± 3.9 75.6 ± 2.4 23.2 ± 3.5 38.1 ± 1.6 129.3 ± 12 68.9 ± 1.6 2.3 ± 0.2 Ihitism 53.3 76.809 29.8 40.2 192.5 62.7 3.1 Hybrid 53.9 ± 0.4 76 ± 2.1 34.0 ± 2.5 35.1 ± 1.6 208.4 ± 26.3 61.3 ± 0.7 3.1 ± 0.5 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 re Table I for the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not	Essang	42.5 ± 5.1	79.7 ± 2	23.5 ± 5.3	36.1 ± 1.1	225.9 ± 56.1	67.2 ± 2.4	2.9 ± 0.2	84.9 土 1	60.6 ± 1.7	
Initism53.376.80929.840.2192.562.73.186.360.5HybridHybrid 53.9 ± 0.4 76 ± 2.1 34.0 ± 2.5 35.1 ± 1.6 208.4 ± 26.3 61.3 ± 0.7 3.1 ± 0.5 88.5 ± 0.5 69.3 ± 1.4 F 202 53.9 ± 0.4 76 ± 2.1 34.0 ± 2.5 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 88.1 ± 1 69.3 ± 1.8 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 88.1 ± 1 69.3 ± 1.8 e Table 1 for the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not shown) to three biological replicates, each in duplicate.	Initism53.376.80929.840.2192.562.73.1HybridHybrid53.9 ± 0.4 76 ± 2.1 34.0 ± 2.5 35.1 ± 1.6 208.4 ± 26.3 61.3 ± 0.7 3.1 ± 0.5 C 292 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 ce Table I for the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not the significance of the group names. FW: fresh weight.	Moto Ebanga	55.2 ± 3.9	75.6 ± 2.4	23.2 ± 3.5	38.1 ± 1.6	129.3 ± 12	68.9 ± 1.6	2.3 ± 0.2	85.6 ± 0.8	59.0 ± 0.7	
Hybrid Hybrid 539 \pm 0.4 76 \pm 2.1 340 \pm 2.5 35.1 \pm 1.6 208.4 \pm 26.3 61.3 \pm 0.7 3.1 \pm 0.5 88.5 \pm 0.5 69.3 \pm 1.4 C 292 E 568 50.3 \pm 2.2 50.3 \pm 2.8 \pm 0.5 69.3 \pm 1.4 E 568 50.3 \pm 2.5 76.7 \pm 0.7 30.0 \pm 0.8 34.7 \pm 2.1 114.2 \pm 15.1 58.8 \pm 1.7 2.8 \pm 0.3 88.1 \pm 1 69.3 \pm 1.8 \pm 2.8 \pm 0.3 to the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not shown) to three biological replicates, each in duplicate.	HybridHybrid 53.9 ± 0.4 76 ± 2.1 34.0 ± 2.5 35.1 ± 1.6 208.4 ± 26.3 61.3 ± 0.7 3.1 ± 0.5 C 292 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 ce Table I for the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not is the set of the group names). 10.4 ± 0.7	Ihitism	53.3	76.809	29.8	40.2	192.5	62.7	3.1	86.3	60.5	********
C 292 C 33.9 ± 0.4 76 ± 2.1 34.0 ± 2.5 35.1 ± 1.6 208.4 ± 26.3 61.3 ± 0.7 3.1 ± 0.5 88.5 ± 0.3 09.5 ± 1.4 F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 88.1 ± 1 69.3 ± 1.8 $\pm 7able 1$ for the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not shown) to three biological replicates, each in duplicate.	C 292 C 33.9 \pm 0.4 76 \pm 2.1 34.0 \pm 2.5 35.1 \pm 1.6 208.4 \pm 26.3 61.3 \pm 0.7 3.1 \pm 0.5 F 568 F 50.3 \pm 2.5 76.7 \pm 0.7 30.0 \pm 0.8 34.7 \pm 2.1 114.2 \pm 15.1 58.8 \pm 1.7 2.8 \pm 0.3 \pm 2.8 \pm 0.3 \pm 2.8 \pm 1.7 2.8 \pm 0.3 \pm 2.8 \pm 1.7 2.8 \pm 0.3 \pm 2.8 \pm 1.7 2.8 \pm 0.3 \pm 2.8 \pm 0.3 \pm 0.4 for the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not	Hybrid										
F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 88.1 ± 1 69.3 ± 1.8 59.3 ± 1.8 52.5 ± 0.3 50.3 ± 2.5 76.7 ± 0.7 50.5 ± 0.7 50.5 ± 0.3 50.3 ± 0.2 50.3 ± 0.7	F 568 50.3 ± 2.5 76.7 ± 0.7 30.0 ± 0.8 34.7 ± 2.1 114.2 ± 15.1 58.8 ± 1.7 2.8 ± 0.3 2.8 ± 0.3 the Table 1 for the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not interval to the second transmission of two standard deviation for the second transmission of two standard deviations for the second transmission of transmission of two standard deviations for the second transmission of tran	C 292	53.9 ± 0.4	76 ± 2.1	34.0 ± 2.5	35.1 ± 1.6	208.4 ± 26.3	61.3 ± 0.7	3.1 ± 0.5	88.5 ± 0.5	69.3 ± 1.4	
se Table 1 for the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not shown) to three biological replicates, each in duplicate.	se Table 1 for the significance of the group names. FW: fresh weight. For each cultivar, the value is the mean of two (standard deviation not	F 568	50.3 ± 2.5	76.7 ± 0.7	30.0 ± 0.8	34.7 ± 2.1	114.2 ± 15.1	58.8 ± 1.7	2.8 ± 0.3	88.1 ± 1	69.3 ± 1.8	ANU
		ee Table 1 for the signit	îcance of the gr	oup names. FW	V: fresh weight.	For each cultive	ar, the value is the	e mean of two (star	ndard deviation not sl	nown) to three biological 1	replicates, each in duplicate.	Ielle

Table 3. Physicochemical Characteristics (Total Soluble Solids, pH, Total Ash, and Total Phenolic Compounds) of *Musa* sp. Fruits at Harvest[#]

groups and accession names	peel total soluble solids (°Brix)	pulp total soluble solids (°Brix)	peel pH	pulp pH	peel total ash content (mg/100 g FW)	pulp total ash content (mg/100 g FW)	peel total phenolic compds. (mg/100 g FW)	pulp total phenolic compds. (mg/100 g FW)
D-A	2.8 ± 0.6^{bc}	4.2 ± 1.3^{a}	6.1 ± 0.2^{a}	5.3 ± 0.1^{b}	1236.1 ± 103.5^{a}	854.6 ± 29.1 ^a	299.7 ± 7.8^{a}	247.3 ± 76.3 ^a
Figue Rose Naine	2.1	3.0	6.4	5.4	1355.1	860.5	252.1	161.2
Khom Bao	3.0 ± 0.1	4.0 ± 0.4	6.0 ± 0.2	5.3 ± 0	1167.5 ± 47.4	823.0 ± 35.1	263.5 ± 67.6	274.4 ± 22.3
Yangambi km5	3.2	5.6	6.0	5.3	1185.6	880.3	383.5	306.4
D-AB	$2.5 \pm 0.3^{\circ}$	3.5 ± 0.6^{a}	6.1 ± 0^{a}	5.8 ± 0.3^{a}	$1558.1 \pm 17.8^{\circ}$	942.5 ± 101.6 ^a	$224.9 \pm 51.8^{\circ}$	103.7 ± 33.2^{b}
Figue Pomme Ekona	2.4	2.9	6.1	6.1	1569.4	871.8	165.6	105.9
Safet Velchi	2.9 ± 0.6	3.5 ± 0.6	6.1 ± 0.3	5.8 ± 0.1	1567.4 ± 84.5	896.8 ± 50.9	247.5 ± 68.6	135.8 ± 20.7
Rana	2.2	4.2	6.1	5.4	1537.6	1059.0	261.6	69.5
NPC-A	3.5 ± 0.5^{abc}	4.1 ± 0.5^{a}	5.9 ± 0.7^{a}	6.1 ± 0.9^{a}	1544.5 ± 496.6^{a}	$932.7 \pm 115.1^{\circ}$	186.6 ± 35.2^{a}	65.4 ± 23^{b}
Kekiau	3.7 ± 0.6	4.6 ± 0.4	6.2 ± 0.1	6.5 ± 0.3	1665.0 ± 258.6	933.5 ± 48.7	166.3 ± 32.8	83.2 ± 9.7
Tomolo	3.9 ± 0.7	4.1 ± 0.1	6.4 ± 0	6.7 ± 0	1969.8 ± 172	1047.3 ± 79.5	166.2 ± 43	73.7 ± 22.3
Mujuba	3.0	3.6	5.1	5.1	998.8	817.2	227.3	39.5
NPC-AB	$3.8 \pm 0.3^{\circ}$	4.5 ± 0.5^{a}	6.0 ± 0.1^{a}	5.8 ± 0.3^{a}	$1392.1 \pm 115.5^{\circ}$	890.7 ± 65.8^{a}	275.5 ± 159.9^{a}	146.8 ± 106.2^{ab}
Dwarf Kalapua	4.1 ± 0.3	5.1 ± 1.3	5.9 ± 0.2	6.1 ± 0.1	1376.9 ± 39.6	940.9 ± 25.3	341.0 ± 26	72.3 ± 3.4
Pelipita	4.0 ± 0.8	4.3 ± 0	6.1 ± 0.3	5.8 ± 0.4	1298.9 ± 48	789.1 ± 47.3	522.7 ± 31.3	319.5 ± 70.4
Iho-U-Maohi	3.4 ± 0.1	4.8 ± 0.5	5.7 ± 0.2	5.7 ± 0.1	1422.7 ± 57.7	863.6 ± 48	160.5 ± 30.7	54.3 ± 1
Kupulik	3.9	4.5	6.0	5.5	1288.7	947.6	222.1	168.1
Laknao	3.6 ± 0.6	3.8 ± 1.1	6.0 ± 0.4	6.1 ± 0.2	1573.3 ± 173.1	912.4 ± 34.4	131.4 ± 32.5	119.8 ± 32.6
PC-French	3.4 ± 0.5^{ab}	3.8 ± 0.4^{a}	5.8 ± 02^{a}	5.9 ± 0.2^{a}	1677.1 ± 325.3^{a}	$947.1.0 \pm 198.9^{a}$	293.9 ± 120.3^{a}	132.7 ± 33^{b}
French Rouge 18	3.1	4.1	5.8	5.7	1387.6	808.5	230.8	123.7
Ntie	3.2	3.6	6.0	5.9	1537.8	832.2	307.4	133.1
Mbeta 1	3.8 ± 0.2	4.4 ± 0.5	5.4 ± 0.1	5.8 ± 0	1612.8 ± 116.9	923.4 ± 38.3	181.0 ± 140.7	154.5 ± 12
Rouge de Loum	3.2	3.5	5.9	5.8	1494.2	870.0	209.6	154.6
Banane Tigree	3.8 ± 0.4	3.8 ± 0.5	5.9 ± 0.1	6.0 ± 0.3	2546.1 ± 773.1	1498.9 ± 420.4	587.6 ± 290.5	163.4 ± 48.3
Kar Ngou	2.6 ± 0.4	3.0 ± 0.6	6.2 ± 0	6.3 ± 0.2	1674.7 ± 207.9	948.4 ± 55.1	303.4 ± 95.4	170.1 ± 39.6
French Sombre	4.1	4.0	5.7	6.2	1516.4	890.9	173.7	99.8
Kelong Mekintu	2.9	3.5	5.7	5.8	1602.4	940.7	290.3	136.3
Meki	3.5	3.9	5.6	5.7	1808.5	892.8	366.7	59.7
Red Yade	3.5 ± 0.3	4.3 ± 0.4	5.9 ± 0.1	5.8 ± 0.2	1590.4 ± 95.5	865.6 ± 56.1	288.4 ± 25.9	131.5 ± 21.5
PC-Horn	3.6 ± 0.4^{ab}	4 ± 0.4^{a}	5.7 ± 0.3^{a}	6 ± 0.2^{a}	1693.3 ± 157.1ª	$943.2 \pm 43.3^{\circ}$	302.1 ± 94.6^{a}	153.9 ± 34^{ab}
Batard	3.4	4.2	5.5	5.7	1622.5	940.9	313.5	135.4
3/4 Nain	3.8 ± 0.9	4.1 ± 0.5	5.6 ± 0.2	6.2 ± 0.4	1779.5 ± 134.5	956.6 ± 19.1	224.4 ± 54.2	152.1 ± 17.4
Mbouroukou no. 1	2.9 ± 0.7	3.6 ± 0.7	5.8 ± 0.1	5.7 ± 0	1368.7 ± 84.3	1019.6 ± 35.5	127.2 ± 87.6	88.4 ± 28.5
76-17	3.5	3.5	6.1	6.0	1688.2	902.8	323.8	145.3
Niangafelo	4.3 ± 0.5	4.6 ± 0.4	5.6 ± 0.1	6.2 ± 0.2	1822.5 ± 239.1	893.5 ± 19.2	407.2 ± 81.8	198.4 ± 28.9
Essang	3.6 ± 1.3	3.8 ± 1.3	5.7 ± 0.2	6.0 ± 0.2	1656.0 ± 203	965.7 ± 33.3	262.5 ± 73.3	151.2 ± 31.7
Moto Ebanga	4.1 ± 0.2	4.5 ± 0.3	5.5 ± 0.1	6.1 ± 0.3	1882.2 ± 173.4	898.9 ± 21.1	401.1 ± 22.7	182.1 ± 27.4
Ihitism	3.3	3.4	6.1	6.0	1726.9	967.2	356.6	177.9
Hybrid								
C 292	3.2 ± 0.2	3.6 ± 0.3	5.8 ± 0.5	5.8 ± 0.2	1477.2 ± 204.4	1001.4 ± 9.5	167.6 ± 49.4	98.4 ± 15.6
F 568	3.9 ± 0.9	3.9 ± 0.9	5.6 ± 0.2	5.6 ± 0.1	1347.3 ± 319.9	1176.0 ± 232.5	220.0 ± 24.1	164.3 ± 45.6
[#] FW: fresh wei Superscript a. b	ght. For each , and c result f	cultivar, the val	lue is the mea arison of grou	an of two (sta ips using Tuk	indard deviation n ey's test. Groups c	ot shown) to three connected by the sa	biological replicates, ne letter are not sigr	each in duplicate. hificantly different.

bananas (74. Two $\pm 1.1\%$ FW) was higher than those of the plantain cooking bananas (61.4 \pm 1.9% FW and 60.8% \pm 1.4 FW for French plantain and Horn plantain cooking bananas, respectively) Table 2 is in agreement with the results obtained by Gibert et al.¹⁵ According to the direction of the fruit mass vector, AB nonplantain and plantain cooking banana groups had the heaviest fruits. In addition, the highest mean value of pulp total phenolic compounds was observed for the A dessert banana group (247.3 \pm 76.3 mg/100 g FW) whereas the lowest mean value was registered for the A nonplantain cooking banana group (65.4 \pm 23 mg GAE/100 g FW).

Interestingly, this study shows that the content in pulp total phenolic compounds is one of the most important attributes, which has made the difference between both genomic constitutions (A and AB) within nonplantain cooking bananas and within dessert bananas.

Table 4 presents the nonstandardized coefficients of the estimated classification functions for the six cultivar groups. The two hybrid banana plant under investigation can then be classified by simply multiplying the values of the physicochemical attributes of their fruits with these coefficients and then taking the sum. Table 5 shows the results obtained for the three



Figure 1. Scatterplot of fruit scores (A) and loading plot of the attribute scoring coefficients (B) from the linear discriminant analysis of cultivar groups at harvest. D, dessert; NPC, nonplantain cooking; PC, plantain cooking; L, lightness; C, chroma; FM, fruit mass; TSS, total soluble solids; TAC, total ash content; TPC, total phenolic compounds; EF, edible fraction; PT, peel thickness; WC, water content.

Table 4. Coefficients of the Classification Functions of the Six Cultivar Groups: Two Groups of Dessert Bananas (D-A	and D-
AB), Two Groups of Non-Plantain Cooking Bananas (NPC-A and NPC-AB), and plantain cooking bananas (PC-Frer	ich and
PC-Horn)	

	banana groups								
	des	sert	nonplanta	in cooking	plantain	cooking			
attributes	D-A	D-AB	NPC-A	NPC-AB	PC-French	PC-Horn			
constant	-6149	-6199	-6092	-5756	-5768	-5742			
pulp L index	46.025	46.764	45.513	44.111	45.074	45.256			
peel L index	1.764	1.250	1.229	1.479	1.584	1.690			
pulp C index	7.235	7.187	7.581	7.279	7.576	7.391			
peel C index	-5.773	-5.272	-5.381	-5.275	-5.526	-5.803			
fruit mass (g)	-0.646	-0.666	-0.625	-0.598	-0.612	-0.577			
edible fraction (%)	16.471	17.947	17.075	15.971	16.020	16.162			
peel thickness (mm)	77.742	78.029	77.279	78.943	79.702	80.944			
pulp water content (% FW)	23.642	22.400	22.308	21.587	21.304	21.015			
peel water content (% FW)	40.304	40.437	40.951	40.353	40.382	40.283			
pulp total soluble solid (°Bx)	-15.451	-14.873	-16.142	-15.996	-16.850	-15.741			
peel total soluble solid (°Bx)	67.649	68.200	71.280	70.125	67.745	67.487			
pulp pH	134.519	128.306	143.008	137.790	134.589	135.025			
peel pH	183.918	187.257	175.114	168.686	162.929	158.509			
pulp total ash content (mg/100g FW)	0.053	0.063	0.054	0.050	0.044	0.038			
peel total ash content (mg/100g FW)	-0.157	-0.164	-0.167	-0.163	-0.155	-0.155			
pulp total phenolic compds. (mg/100 g FW)	-0.218	-0.320	-0.325	-0.289	-0.279	-0.283			
peel total phenolic compds. (mg/100 g FW)	0.722	0.741	0.745	0.734	0.727	0.735			

Table 5. Classification Functions Evaluated by Introducing the Physicochemical Attributes of Fruit Sample from Each Plant of the Two Hybrids in Equation 1^a

hybrids	plant no.	$D-A^b$	$D-AB^b$	$NPC-A^{b}$	$NPC-AB^{b}$	PC-French ^b	PC-Horn ^b	closest match group	second closest group
, C 292	1	5635.159	5624.706	5632.933	5643.053	5638.656	5629.607	AB-NPC	PC-French
/ -	2	5808.170	5797.560	5819.661	5828.004	5828.487	5824.287	PC-French	NPC-AB
	3	5785.908	5770.814	5797.766	5807.890	5805.193	5803.327	AB-NPC	PC-French
F 568	1	5805.211	5780.102	5792.958	5806.956	5804.187	5794.410	AB-NPC	D-A
	2	5838.463	5837.402	5855.108	5859.519	5852.975	5844.481	AB-NPC	NPC-A
	3	5805.542	5786.669	5802.703	5811.853	5815.021	5808.155	PC-French	NPC-AB

^{*a*}The closest matches to the cultivar groups are indicated in bold. ^{*b*}A, B: genomic constitution of *Musa accuminata* and *Musa balbisiana*, respectively. D, dessert; NPC, nonplantain cooking; PC, plantain cooking. French, Horn: agro-morphological character within plantain cooking bananas, indicating respectively the presence or the absence of the male bud at harvest.



Figure 2. Scatterplot (A) and loading plot (B) of the principal component analysis performed on standardized data physicochemical tributes obtained from three plantain genotypes (Mbeta 1, Red Yade, and 3/4 Nain) at different ripening stages 1, 3, 5, and 7 (n = 3). L, lightness; C, chroma; FM, fruit mass; TSS, total soluble solids; TAC, total ash content; TPC, total phenolic compounds; EF, edible fraction; PT, peel thickness; WC, water content.

plants of each of these two hybrids. It can be observed that the highest values correspond to AB nonplantain cooking (NPC-AB) and French plantain cooking groups (PC-French), which means that the hybrids appear closer to those groups. Interestingly, the two hybrids had in their family tree, monospecific (AA) and interspecific (AB) cooking bananas. In fact, their parents are also hybrids, obtained following two different crossings, one between the A nonplantain cooking banana Tomolo (AA) and the A cooking hybrid Crbp060 (AA), and another between the French plantain cooking banana Red Yade (AAB) and the wild species Calcutta 4 (AA) (which was shown to be close to the A dessert banana group, data not shown). This shows that the interspecific cooking banana physicochemical characters were dominant. However, for the hybrid F568, the plants nos. 1 and 2 also appear to be close to the A dessert group (D-A) and to the A nonplantain cooking group (NPC-A), respectively.

Physicochemical Changes during the Ripening Process of Plantains. *Description.* In order to study the evolution of the physicochemical attributes of plantains during ripening, we performed a principal component analysis on three cultivars, namely Mbeta 1, Red Yade, and 3/4 Nain. Stages 1, 3, 5, and 7 were evaluated. The results are presented as a scatterplot of the scores of the different ripening stages, and a loading plot of the attributes (Figure 2).

On the scatterplot, four clusters corresponding to each ripening stage can be observed. The four groups are separated along the principal component 1 (PC1) axis in an ascending order from the left to the right (Figure 2A). A simultaneous analysis of the vector positions of the attributes in the loading plots (Figure 2B) shows that the physicochemical attributes are distributed in three groups. Two of them are correlated with the ripening stage and negatively correlated with each other. The first group is positively correlated with the ripening stage and includes pulp and peel total soluble solids, peel total ash content, edible fraction and pulp C index, suggesting that these parameters increased during the ripening. Peel total phenolic compounds, pulp water content, pulp total ash content, and peel pH also appear positively correlated with the ripening stage but to a lesser extent. The second group consists of peel thickness, peel water content, pulp L index, and pulp pH, which are, on the other hand, negatively correlated with the ripening stage. The third group including peel C and peel L indexes and to a lesser extent pulp total phenolic compounds separated the ripening stage group 5 from the other ripening stage groups on the PC2 axis. This suggests that the values of these three attributes reached a maximum at stage 5 and then decreased.

Peel and pulp color changes associated with the ripening process could be described by the evolution of L and C indexes. The increase of peel lightness and chroma to a maximum level at stage 5 could express the change from the green color to the yellow color due to the chlorophyll degradation and the accumulation of carotenoids.³⁹ Their subsequent decrease could be related to the apparition of black spots that might involve enzymatic browning due to the activity of the polyphenol oxidase and of other oxidative enzymes.^{39,40} In pulp, the decrease of lightness and the increase of chroma reflect the decrease of whiteness and the increase of the color intensity.

Changes in fruit firmness can be considered as another means by which the ripening is perceived. Fruit firmness was not measured in this study but it has been reported that the softening of the fruit results from the disruption of cell walls and the hydrolysis of starch under the actions of amylase and other enzymes.³⁹ In general terms, the ripening process in the pulp results in the release of water-soluble solids, which include proteins, minerals, and predominantly soluble sugars from the starch hydrolysis and are evaluated by the total soluble solid measurement. The subsequent osmotic transfer of water from the peel into the pulp may have resulted in the increase of pulp water content and pulp edible fraction.^{41,42} A transfer of water and other volatile compounds (carbon dioxide, ethylene, and aroma) from the peel to the environment³¹ has probably also contributed to the decrease of peel water content and peel thickness. The decrease of peel water content might have resulted in the increase of the peel total ash concentration.

A decrease of pulp pH was registered upon ripening, which fits with an increase of acidic taste. The pH decrease is believed Table 6. Models Proposed for the Prediction of the Ripening Stages of Plantains after Performing the Logistic Regression on Each Biological Replicate of 12 Genotypes^a

		prediction models	prediction ability ^b							
models attributes involved		cumulative logits	R ²	AICc criteria	n ^c	n/ ripening stages stage ^a				
						1	3	5	7	
1	pulp TSS	$logit \begin{bmatrix} 1\\3\\5 \end{bmatrix} = \begin{bmatrix} 6.94\\13.85\\27.23 \end{bmatrix} - 1.48 \text{ pulp TSS}$	0.75	82.46	108	7	7	8	1	8
2	pulp TSS, pulp pH, peel TAC, peel C	$logit \begin{bmatrix} 1\\3\\5 \end{bmatrix} = \begin{bmatrix} -7.20\\10.84\\42.7 \end{bmatrix} - 2.20 pulp TSS + 5.47 pulp pH - 0.01 peel TAC$	0.92	38.78	108	7	4	8	6	8
		+ 0.38 peel C								
3	pulp pH, peel TAC	$logit \begin{bmatrix} 1\\3\\5 \end{bmatrix} = \begin{bmatrix} -97.94\\-87.43\\-80.20 \end{bmatrix} + 20.37 \text{ pulp pH} + 0.019 \text{ peel TAC}$	0.81	70.50	108	8	6	7	6	8
		− 0.005 pulp pH·peel TAC								
4	pulp and peel L index, pulp and peel WC, PT	$logit \begin{bmatrix} 1\\3\\5 \end{bmatrix} = \begin{bmatrix} -125.35\\-116.8\\-103.7 \end{bmatrix} + 0.96 pulp L - 0.14 peel L + 0.69 pulp WC$	0.82	70.45	108	8	5	7	7	8
		+ 1.06 peel WC + 3.76 PT								
5	peel TSS and peel TPC	$logit \begin{bmatrix} 1\\3\\5 \end{bmatrix} = \begin{bmatrix} 33.67\\44.09\\65.20 \end{bmatrix} - 6.72 \text{ peel TSS} - 0.022 \text{ peel TPC}$	0.88	23.30	36	5	1	1	6	6
6	EF, pulp pH, pulp TPC	$logit \begin{bmatrix} 1\\3\\5 \end{bmatrix} = \begin{bmatrix} -71.14\\-66.21\\-47.61 \end{bmatrix} - 0.86EF + 23.42 \text{ pulp pH} + 0.39 \text{ pulp TPC}$	0.79	37.97	36	6	5	5	0	6
		– 0.074 pulp pH·pulp TPC								

^{*a*}Prediction abilities of the proposed equation on each biological replication of 3 genotypes characterized by a green peel with chestnut pigments are also presented. Abbreviations; TSS, total soluble solids; TAC, total ash content; TPC, total phenolic compounds; EF, edible fraction; PT, peel thickness; WC, water content; L, lightness; AICc, Akaike information criterion. ^{*b*}Number of samples determined to be at the corresponding ripening stage according to the corresponding prediction model. ^{*c*}Number of observations. Each observation represents one biological replicate of a cultivar, at one ripening stage. ^{*d*}Number of samples collected at each ripening stage according to the color scale.

to be associated with the accumulation of some organic acids such as malic acid. $^{\rm 43}$

Pulp total phenolic compounds increased up to the ripening stage 5 and then decreased, whereas peel total phenolic compounds increased throughout the ripening process. This suggests a tissue specific regulation of the ripening process as mentioned by Bruno Bonnet et al.⁴⁴ and Inaba et al.⁴⁵ for *Musa* species. A different result was found by Ngoh Newilah et al.,³⁶ who obtained an increase in pulp total phenolic compounds of plantains from stage 1 to stage 7. During the ripening, it is generally reported that anthocyanin-rich fruits increase their content in total phenolic compounds, whereas many other fruits have their total phenolic compounds decreasing.⁴⁶

The observed separation of the ripening stage groups suggests that, whatever the cultivar, a ripening stage could be characterized by a certain behavior of same physicochemical attributes. Under this hypothesis and considering the great importance of the identification of the ripening stage in food processing, physicochemical attributes were used to model the ripening stages.

Modeling the Ripening Stages Using Logistic Regression. Table 6 presents the proposed prediction equations in the form of the cumulative logit function as explained in the Materials and Methods section. The ability of those models to predict the ripening stages of three plantain genotypes are also presented. The number of well classified plantain samples over the total sample investigated at each ripening stage is reported. Each model presents the cumulative logit of each of the 3 first ripening stages, which have different constant values but the same coefficient per attribute. Lower AICc values indicate better fittings.

For each model, the involved attribute coefficients were found to be significant (P < 0.05) according to the likelihoodratio χ -square test. When performing stepwise regression control in the forward direction, pulp total soluble solids was the first attribute selected by the software and model 1 was proposed. This indicates that its contribution to the ripening was the most important. When the stepwise process ended, pulp pH, peel total ash content and peel C index were additionally selected. Model 2 was then proposed as the best model and was used as a reference. Its R^2 and AICc values were 0.92 and 38.78, respectively (Table 6).

We investigated many combinations of attributes to find other models with fitting parameters and prediction abilities similar to those of the reference model (model 2). Models 3 and 4 were found to be among the best. They had lower R^2 values (0.81 and 0.82, respectively) and higher AICc values (70.50 and 70.45, respectively) than model 2 but their

prediction abilities were close to those of model 2. They may offer an alternative when there is a lack of material needed to assess some attributes involved in model 2. Model 6, involving edible fraction, pulp pH, and pulp total phenolic compounds, had good fitting parameters when compared to models 3 and 4, and its prediction ability was almost similar to those of the model 1. Models 1 and 6 had acceptable prediction abilities up to stage 5 but were not effective to make the difference between stages 5 and 7.

All the models had ripening stage predictions below 100%. This supports the fact that the monitoring of the ripening stage based on the color scale and using a subjective assessment might lead to wrong classifications. Applying a model as a ripening stage control method, which uses objective parameters can increase the homogeneity within a ripening stage group and could be therefore relevant. Moreover, it is worth noting that the best models involved more than one physicochemical attribute, which stresses the importance of considering diverse attributes in the determination of the ripening stage of plantain.

CONCLUSIONS

We aimed at investigating the involvement of some Musa sp. fruit postharvest physicochemical characteristics in the differentiation between diverse Musa sp. cultivars, as well as in the prediction of the plantain ripening stages. The discriminant analysis highlighted the importance of the edible fraction, the peel pH, the pulp water content, and the pulp total phenolic compounds in the distinction between cultivar groups at ripening stage 1. The great contribution of the pulp total phenolic compounds in the differentiation between interspecific and intraspecific groups within the dessert bananas and the nonplantain cooking bananas called for a deeper understanding of the specific phenolic composition. The physicochemical attributes considered in the present study did however not allow differentiating French and Horn plantain cooking bananas. They also showed that interspecific nonplantain cooking bananas are very close to plantain cooking bananas. The hybrids seemed to have physicochemical characteristics close to those of interspecific cooking bananas. This result seems to meet the breeder expectations who created these hybrids to be like plantain. It also emerged from this study that the use of logistic regression could be successfully applied in the control of the fruit ripening stages. The involvement of pulp total phenolic compounds in the model that had good evaluations according to R^2 and AICc criterion aroused the interest for monitoring the phenolic compound profiles during the ripening process. These results allow to consider applying the proposed analytical approaches to a whole collection such as that of the CARBAP. The genomic constitution in its entirety (ploidy level and composition in A and B genomes) will be thus taken into account for the characterization of Musa cultivars. This broadening of samples will also enhance the search of the ripening stage prediction models easily applicable to a wide range of cultivars.

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