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Leaf and fruit description of 18 varieties of mango tree (*Mangifera indica* L.) in Burkina Faso

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Fruit cultivation, particularly mango production, is flourishing in Burkina Faso. Despite the abundance of mango varieties, the methods for identifying them based on morphological traits remain unknown. This study aims to identify the distinctive characteristics of 18 mango tree varieties at INERA/Farako-Bâ, where experimentation is ongoing. To achieve this, 18 qualitative and four quantitative parameters were employed to characterize the varieties. The characterization followed a completely randomized Fisher block design. The study unveiled significant morphological variability, discerned through various qualitative and quantitative variables related to leaves and fruit. The resulting dendrogram from the analysis of variance grouped the varieties into three classes. The first class comprises varieties with elliptical leaf blades. The second class includes seven varieties with oval-shaped blades, while the third class consists of five varieties with oblong limbs. In terms of fruit characteristics at physiological maturity, the coloration of the epidermis and the shape of the fruit were crucial for describing each mango variety, facilitating their identification. The study's findings emphasize the high value of these mango varieties as an essential resource for varietal breeding programs.

Key words: Description, leaves, fruits, varieties, mango tree, Burkina Faso.

INTRODUCTION

The mango tree (*Mangifera indica L.*) stands as one of the most widely cultivated fruit trees in tropical and subtropical regions (Grant et al., 2015). In Burkina Faso, the primary mango production areas are concentrated in the western part of the country, particularly in the provinces of Kénédougou, Comoé, Houet, and Léraba. The fresh mango yield for 2022 was estimated at 102,211 tonnes (APROMAB, 2022), solidifying mango as the

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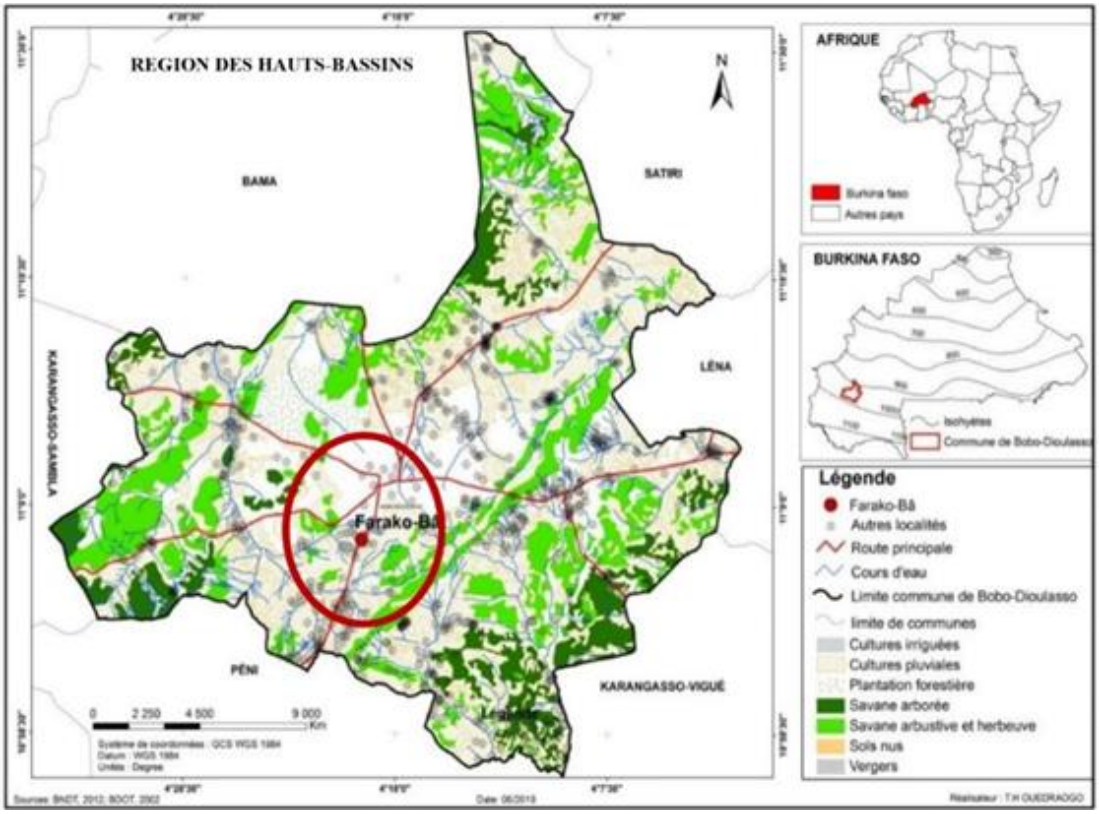

Figure 1. Geographic location of the study site.

nation's most crucial fruit, often referred to as the 'first national fruit.' In the Hauts-Bassins, Mouhoun, and Center-West regions, mango production reached an estimated 305,000 tonnes during the 2021 season (Agro Dev, 2020). Among the 22 mango tree varieties documented in orchards in the West and Center-West regions, ten are commonly adopted by producers: Amélie, Brooks, Kent, Keitt, Lippens, Glazier, Valencia, Alphonso, Francis, and Springfield. Globally, mango tree varieties are categorized as either ordinary (polyembryonic) or improved (mono-embryonated) (Barua, 2020). Ordinary varieties can be propagated by seed as they produce several seedlings from a single seed (polyembryonic) (Fatimah et al., 2016). Despite the diversity of mango tree varieties in Burkina Faso, their agronomic performance remains unknown. Considering the booming agricultural and food sector, there is a need to characterize mango tree varieties to optimize production. Hence, this study aims to identify the distinctive characteristics of 18 mango tree varieties in Burkina Faso.

MATERIALS AND METHODS

Study site

"The study was conducted at the Centre of Environmental and Agricultural Research and Training of INERA in Farako-Bâ, situated approximately ten kilometers south of Bobo-Dioulasso (04°20' west longitude, 11°60' north latitude, and 450 m altitude), along the Bobo-Banfora road axis (Figure 1). The station spans 475 ha, with 375 ha dedicated to experimental plots.

Materials

The plant material consisted of 18 mango tree varieties, sourced from the grafts of the INERA/Banfora varietal collection (Table 1). These varieties were selected based on their proven high yields, successful grafting abilities, and significant market demand in Burkina Faso (Sawadogo et al., 2001).

Methods

The experimental setup employed a Fisher block design with three repetitions, each including the 18 mango tree varieties. The planting spacing was 5 m × 5 m, resulting in a total of 270 plants covering an area of 6750 m² within the INERA/Farako-Bâ center. Following UPOV (2006) requirements, five leaves from each variety were harvested from two mango plants. Leaf length and width were measured using a double decimeter.

Mango fruits were harvested from the varietal collection of mango trees at INERA/Banfora. In April 2021, five mango fruits from two trees of each variety were harvested at physiological maturity, adhering to UPOV (2006) standards. Post-harvest, the mangoes were stored in an air-conditioned room until reaching commercial maturity (physically ripe mango). The leaves and fruits were collected randomly from all sides of the tree. Qualitative and

Table 1. List of plant material.

No.	Varieties	Type of seed	No.	Varieties	Type of seed
1	Sensation	Mono-embryonic	10	Alphonso	Mono-embryonic
2	Glazier	Mono-embryonic	11	Keitt	Mono-embryonic
3	Brooks	Mono-embryonic	12	Amélie	Mono-embryonic
4	Miami-late	Mono-embryonic	13	Mangot vert	Poly-embryonic
5	Valencia	Mono-embryonic	14	Mangot sabre	Poly-embryonic
6	Zill	Mono-embryonic	15	Dixon	Mono-embryonic
7	VSB	Mono-embryonic	16	Bewerly	Mono-embryonic
8	Springfield	Mono-embryonic	17	Francis	Mono-embryonic
9	Kent	Mono-embryonic	18	Lippens	Mono-embryonic

Table 2. Qualitative variables of the leaves during the experiment.

No.	Measured Variables	Descriptions
1	Limb twist (TL)	Observed on 5 leaves per variety
2	Leaf blade shape (FL)	Observed on 5 leaves per variety
3	Leaf blade color (CL)	Observed on 5 leaves per variety
4	Base shape (FB)	Observed on 5 leaves per variety
5	Undulation of the edge of the blade (OBL)	Observed on 5 leaves per variety
6	Vertex shape (FS)	Observed on 5 leaves per variety

Table 3. Qualitative variables observed on fruits.

No.	Variables measured	Description of measurement
1	Predominant color of the epidermis (CPE)	Observed on 5 fruits per variety at physiological maturity
2	Peduncular cavity (CP)	Observed on 5 fruits per variety at physiological maturity
3	Presence and length of the collar (PC and LC)	Observed on 5 fruits per variety at physiological maturity
4	Ventral shoulder shape (FEV)	Observed on 5 fruits per variety at physiological maturity
5	Dorsal shoulder shape (FED)	Observed on 5 fruits per variety at physiological maturity
6	Length of the furrow in the ventral shoulder (LSEV)	Observed on 5 fruits per variety at physiological maturity
7	Depth of the sulcus in the ventral shoulder (PSEV)	Observed on 5 fruits per variety at physiological maturity
8	Outgrowth on the ventral shoulder (EEV)	Observed on 5 fruits per variety at physiological maturity
9	Presence of the sinus (PS)	Observed on 5 fruits per variety at physiological maturity
10	Sinus depth (PSi)	Observed on 5 fruits per variety at physiological maturity
11	Proximal outgrowth of the stylar scar (EPCS)	Observed on 5 fruits per variety at physiological maturity
12	Point to stylar scar (PCS)	Observed on 5 fruits per variety at physiological maturity

quantitative data were then collected on each mango variety at physiological maturity, following UPOV guiding principles.

Data collection

A total of 22 genetic traits were measured and observed, comprising 18 qualitative and four quantitative parameters. Qualitative variables were recorded for both leaves (Table 2) and fruits (Table 3), while quantitative variables from the leaves were documented (Table 4).

Data analysis

Data entry and calculation of the frequencies of qualitative characters were conducted using Excel 2016. For quantitative traits, an analysis of variance (ANOVA) was performed using XLSTAT 2016 software, and means were separated using the Newman-Keuls test at the 5% threshold. An ascending hierarchical classification (CAH) was carried out to group individuals based on the Ward aggregation method using Euclidean distance.

RESULTS

Variation in leaf shape of mango varieties

Mango tree varieties showed variations in leaf shape (Figure 2). Concerning the variable twisting of the leaf

Table 4. Quantitative parameters measured on the leaves during the experiment.

No.	Measured Variables	Descriptions
1	Number of secondary veins pairs (NPNS)	Determined by counting the number of veins on 5 leaves per plant
2	Length of the leaf blade (LongLe)	Assessed by measuring from the base to the tip of the blade on 5 leaves per plant
3	Width of the blade (largLe)	Evaluated by measurement at the lower 1/3 (widest part) on 5 leaves per plant
4	Petiole length (LongPe)	Measured on 5 leaves per plant from the insertion of the branch to the base of the blade

blade, all the studied varieties presented a single modality characterized by the absence of twisting of the leaf blade (Figure 2b). For the shape of the blade, the varieties Alphonso, Francis, VSB, Mangot vert, Mangot sabre, Sensation, Miami-late, Keitt, Valencia, and Springfield presented the elliptical shape (Figure 2c). The oval shape was observed in Dixon, Bewerly, Amélie, and Glazier (Figure 2h). The varieties Lippens, Zill, Kent, and Brooks presented the blade's oblong shape (Figure 2d). Concerning the color of the leaf blade, the varieties Zill, Amélie, Glazier, Valencia, and Springfield presented yellow-green coloring (Figure 2f). The dark green coloration of the blade was observed in Alphonso, Francis, VSB, Mangot vert, Mangot sabre, Sensation, Miami-late, Keitt, Dixon, Bewerly, Lippens, Kent, and Brooks (Figure 2c).

For the shape of the base of the leaf, the obtuse shape was observed in the varieties Alphonso and Bewerly (Figure 2c). The acute form was revealed by the varieties Valencia, Springfield, Brooks, Keitt, Lippens, Zill, Amélie, Mangot vert, Mangot sabre, Sensation, VSB, Dixon, and Francis (Figure 4o). The rounded shape was presented by the varieties Miami-late, Glazier, and Kent (Figure 2a).

For the shape of the top of the leaf, the acuminate form was presented by the varieties Springfield, Brooks, Keitt, Glazier, Miami-late, Mangot vert, Mangot sabre, Sensation, VSB, Dixon, and Francis (Figure 4l). The acute form was revealed by the Alphonso and Kent varieties (Figure 2c). Concerning the top of the leaves, the varieties Valencia, Lippens, Amélie, Zill, and Bewerly showed a pointed shape (Figure 4m). The blade edge undulation was exhibited by the varieties Lippens, Zill, Bewerly, Springfield, Brooks, Miami-late, Keitt, Sensation, Alphonso, Dixon, and Francis (Figure 2d). However, the VSB, Glazier, Mangot vert, Mangot sabre, Amélie, Kent, and Valencia did not present any undulation of the edge of the leaf blade (Figure 2a).

Variation in quantitative leaf characters

The analysis of the quantitative character data showed a highly significant difference at the 5% threshold (Table 5). Concerning the variable leaf blade length (LongLe), the variety Amélie presented the longest leaves with an average leaf blade of 24.69±1.71 cm. Regarding leaf blade length, the variety Amélie is statistically equivalent to the varieties VSB, Mangot vert, Mangot sabre, Springfield, Sensation, Zill, Bewerly, and Dixon. On the other hand, the variety Kent presented the shortest leaves with an average of 13.46±2.02 cm. For the blade width parameter (largLe), the VSB variety showed the widest leaves with an average width of 6.56±0.61 cm. The VSB variety is statistically equivalent to the Francis, Amélie, Miami-late, Springfield, and Alphonso varieties for this parameter. Conversely, the variety Kent presented thin leaves with an average blade width of 3.44±0.83 cm.

Regarding the variable petiole length (longPe), the leaves of the Francis, VSB, and Keitt varieties presented long petioles with mean lengths of 4.61±1.59 cm, 4.41±0.82 cm, and 3.92±4.42 cm, respectively. These varieties are statistically equivalent to the varieties Amélie, Miami-late, Mangot vert, Mangot sabre, Sensation, Zill, Bewerly, Alphonso, Dixon, Glazier, Valencia, Lippens, and Brooks considering the petiole length. Conversely, the variety Kent showed the shortest petioles (1.65±0.49 cm). Finally, for the number of secondary veins (NPNS) pairs, the Keitt variety showed densely venated leaves (25.70±2.96). For this parameter, the variety Keitt is statistically non-distinct from the varieties VSB, Francis, Miami-late, Lippens, Mangot sabre, Mangot vert, Springfield, Bewerly, Alphonso, Glazier, Valencia, Brooks, and Kent. As for the variety Dixon, it had less densely venated leaves (19.80±1.77).

Structuring of mango tree varieties according to the shape of the leaves

The dendrogram showed the distribution of the 18 varieties into three classes (Figure 3). The first class (C1), represented by five varieties including Brooks, Kent, Keitt, Alphonso and Lippens, with as central object the Brooks variety. The leaves of this class of varieties have oblong-shaped blades. The second class (C2) comprised six varieties including Amelie, Zill, Dixon, Sensation, VSB and Springfield. This class has as its central object the variety Sensation. The leaves of varieties of this class have elliptical-shaped blades. The third class (C3) was represented by seven varieties including Francis, Bewerly, Valencia, Glazier, Miami-late, Mangot vert and Mangot sabre, with in the center the variety Bewerly. The

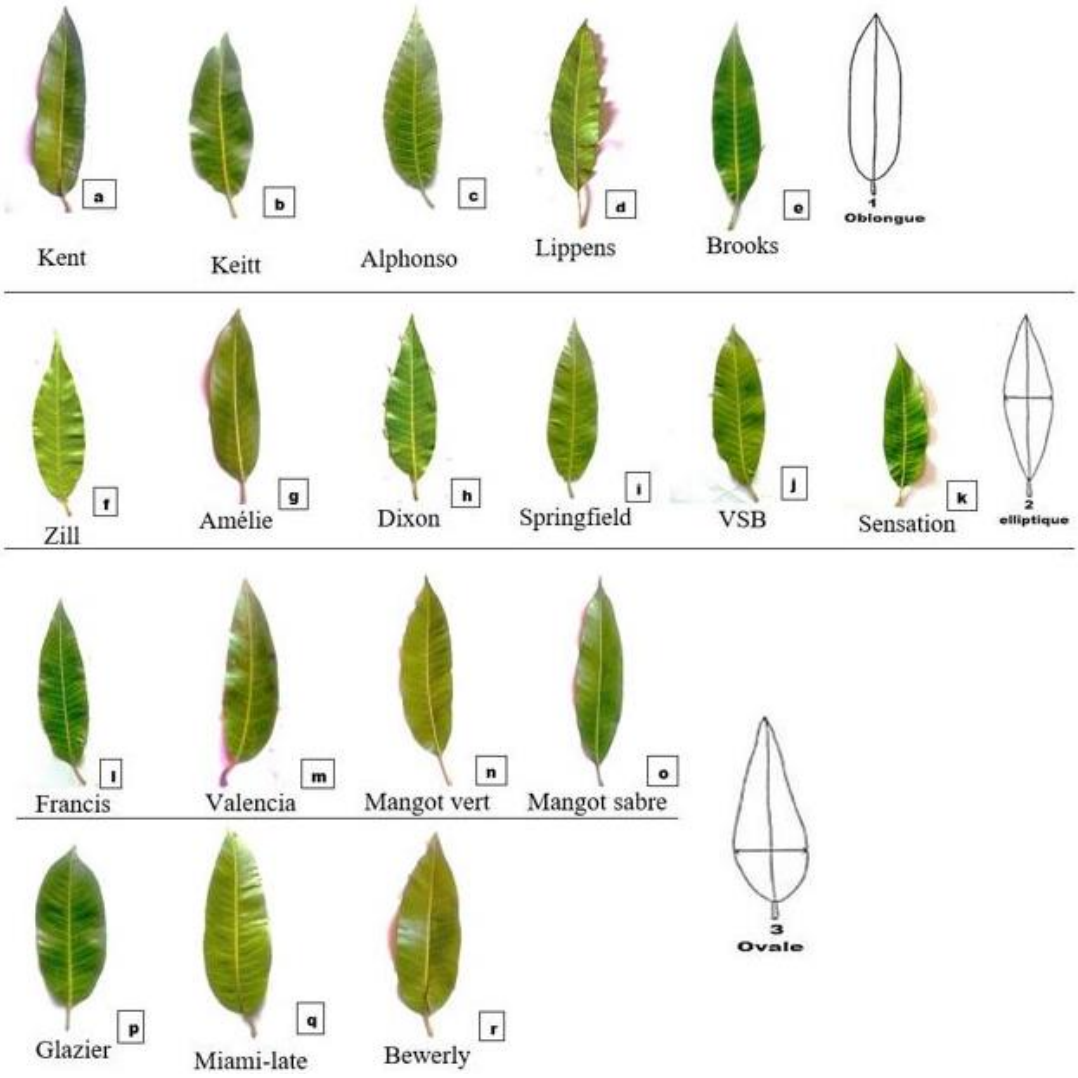

Figure 2. Variations in leaf shapes of 18 varieties of mango tree.

leaves of varieties of this class have oval-shaped blades.

Variation in fruit quality characteristics

An important variability was observed among varieties for the qualitative characteristics at the physiological maturity of fruits (Figure 4). For the character "color of the skin" (CE), the immature fruits of the varieties Alphonso, Zill, Brooks, Glazier, Bewerly, VSB, Amélie, Lippens, Mangot vert, Mangot sabre, Francis, and Valencia presented a green color (Figure 4p). The fruits of the varieties Dixon, Miami-late, Sensation, Kent, and Keitt exhibited a combination of green and purple colors, with Sensation as the control (Figure 2d), and the variety Springfield displayed green and red coloration (Figure 2c).

The peduncular cavity (CP) was shallow in the varieties Dixon, Valencia, Lippens, Springfield, Mangot sabre, Bewerly, and Sensation, with the Ruby variety as a control (Figure 2i). It was of average depth in the varieties Alphonso, Brooks, Amélie, Miami-late, Mangot vert, Francis, and Keitt, with the Haden variety as a control (Figure 4n). It was deep in the Kent, Zill, Glazier, and VSB varieties (Figure 2a).

At the crown level (PC and LC), the peduncular cavity was absent in the varieties Alphonso, Kent, Zill, Brooks, Sensation, Glazier, VSB, Bewerly, Amélie, Springfield, Miami-late, Lippens, Mangot vert, Mangot sabre, Dixon, and Keitt, with Zill as a control (Figure 2b). On the other hand, it was present and of medium length in the Francis and Valencia varieties, with the Ruby variety as a control (Figure 2k).

For the ventral shoulder shape (FEV) character, the ventral shoulder of fruits in the Alphonso, Kent, Brooks, Mangot vert, Sensation, and Glazier varieties was rounded upwards, with the Tommy Atkins variety as a

Table 5. Comparison of the means of the quantitative foliar variables of the varieties.

Variety	Long Le (cm)	Larg Le (cm)	Long Pe (cm)	NPNS
		Means ± Standard deviations		
VSB	22,50 ±1.81 abcd	6.56 ±0.61 ab	4.41 ±0.82 ab	22.90 ±0.70 abcd
Francis	19.97 ±3.40 bcdefg	5.72 ±0.54 bcd	4.61 ±1.59 ab	23.60 ±3.58 abcd
Amélie	24.69 ±1.71a	5.62 ±0.47 bcd	3.51 ±1.12 bcd	22.30 ±1.84 bcd
Miami-late	19.49 ±3.12 bcdefg	6.19 ±1.09 bc	3.72 ±1.53 bcd	23.40 ±0.80 abcd
Mangot vert	21.96 ±3.21 abcde	4.82 ±0.41 def	2.98 ±0.76 bcd	25.40 ±3.74 ab
Mangot sabre	21.52 ±1.73abcd e	4.97 ±0.63 def	3.28 ±0.70 bcd	24.60 ±2.83 abc
Keitt	15.46 ±1.44 hi	4.96 ±0.88 def	3.92 ±4.42 abc	25.70 ±2.96 ab
Springfield	21.61 ±1.57 abcde	5.81 ±0.59 bcd	2.00 ±0.33 cd	23.10 ±2.73 abcd
Sensation	21.04 ±1.62 abcdef	5.25 ±0.59 cde	3.47 ±0.70 bcd	22.10 ±1.86 bcd
Zill	21.69 ±2.22 abcde	4.99 ±0.81 def	3.41 ±1.23 bcd	20.50 ±2.90 cd
Bewerly	20.86 ±4.82 abcdefg	5.26 ±0.72 cde	2.82 ±0.72 bcd	23.10 ±1.81 abcd
Alphonso	17.20 ±1.07 gh	5.66 ±0.44 bcd	2.57 ±0.94 bcd	23.70 ±3.82 abcd
Dixon	21.32 ±2.90 abcde	5.30 ±0.70 cde	2.76 ±0.99 bcd	19.80 ±1.77 d
Glazier	19.11 ±1.89 cdefg	5.42 ±0.77 cde	2.57 ±0.53 bcd	23.20 ±4.21 abcd
Valencia	18.70 ±2.12 defgh	4.98 ±0.46 def	3.32 ±0.50 bcd	23.10 ±2.73 abcd
Lippens	18.33 ±4.20 efgh	4.12 ±1.19 f	2.81 ±0.54 bcd	25.10 ±2.25 ab
Brooks	17.41 ±1.86 fgh	4.87 ±0.66 def	2.74 ±0.62 bcd	24.00 ±2.09 abcd
Kent	13.46i ±2.02	3.44 ±0.83 g	1.65 d ±0.49	24.20 ±2.71 abc
dof	17	17	17	17
F	9.84	11.18	4.04	3.65
Pr > F	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Significant	THS	THS	THS	THS

The values of the numbers bearing the same letters in the same column are statistically equivalent to the 5% threshold (Newman-Keuls test) for the parameter considered. The values preceding the ± sign designate the standard deviations between the different repetitions. LongLe: Length of the blade; Width: width of the leaf blade; LongPe: Length of the petiole; NPNS: Number of pairs of secondary veins; Pr: probability; HRT: very highly significant (p<0.001); dof: degree of freedom.

control (Figure 4p). It was rounded downwards for the Keitt and Francis varieties, with Keitt as a control (Figure 2f). In the varieties Zill, Bewerly, VSB, Amélie, Springfield, Miami-late, Lippens, Mangot sabre, Valencia, and Dixon, the ventral shoulder of the fruits was rounded horizontally, with Zill as a control (Figure 2b).

For the dorsal shoulder shape (FED) character, the dorsal shoulder of fruits in the Keitt, Mangot vert, and Miami-late varieties was inclined downward, with Keitt as a control (Figure 4f). It was rounded horizontally in the varieties Alphonso, Kent, Brooks, Sensation, Bewerly, and Valencia (Figure 4p). It was rounded towards the bottom in the varieties Dixon, Lippens, Springfield, VSB, Mangot sabre, Glazier, and Zill, with Zill as a control (Figure 4b). Finally, it abruptly breaks in Amélie and Francis, with the Palmer variety as a control (Figure 4o).

For the trait length of the furrow in the ventral shoulder (LSEV), the furrow was short in the varieties Alphonso, Kent, Zill, Brooks, Sensation, Glazier, Bewerly, VSB, Springfield, Lippens, Valencia, Mangot vert, Mangot sabre, Dixon, and Keitt (Figure 4p). It was medium in Amélie (Figure 4o) and long in the Francis and Miami-late varieties (Figure 4k).

For the character depth of the furrow in the ventral shoulder (PSEV), the furrow was shallow in Alphonso, Kent, Brooks, Sensation, Glazier, Bewerly, VSB, Springfield, Miami-late, Lippens, Valencia, Mangot vert, Mangot sabre, Dixon, and Keitt (Figure 4p). It was medium in Amélie (Figure 4o) and deep in Zill and Francis (Figure 2b).

For the character excrescence on the ventral shoulder (EEV), the excrescence was present in Alphonso, Kent, Zill, Brooks, Sensation, Keitt, and Francis, with Zill as a control (Figure 4b). However, it is absent in Dixon, Valencia, Lippens, Miami-late, Springfield, Amélie, VSB, Mangot vert, Mangot sabre, Bewerly, and Glazier, with the Ruby variety as a control (Figure 2i).

For the variable "presence of sinus" (PS), it was visible in Alphonso, Zill, Brooks, Amélie, Springfield, Lippens, Francis, Valencia, and Dixon (Figure 4p). However, it is invisible in Keitt, Miami-late, VSB, Bewerly, Glazier, Mangot vert, Mangot sabre, Sensation, and Kent, with Kent as a control (Figure 4o).

For the sinus depth character (PSi), the varieties

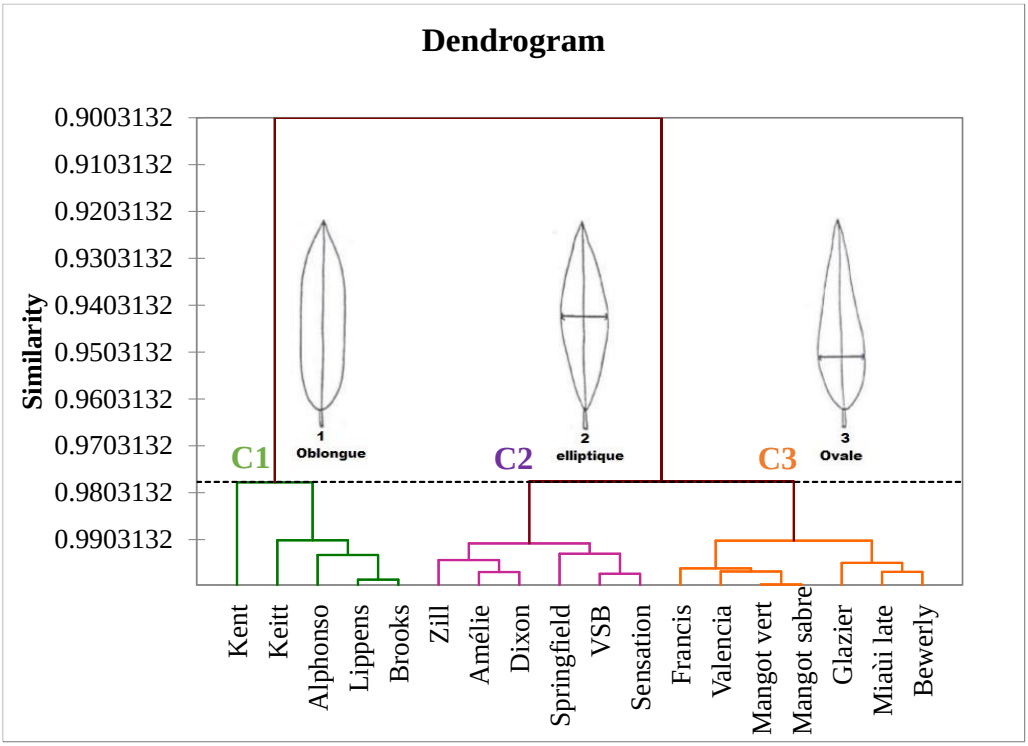

Figure 3. Dendrogram grouping varieties according to leaf morphological variables.

Alphonso, Kent, Zill, Brooks, Sensation, Glazier, Bewerly, VSB, Amélie, Springfield, Miami-late, Lippens, Mangot vert, Mangot sabre, Valencia, and Keitt present a shallow sinus (Figure 4p). On the other hand, in Dixon and Francis, the sinus is deep (Figure 4l).

For the trait "Proximal Outgrowth of the Stylary Scar" (EPCS), the outgrowth was visible on the fruits of the Keitt, Miami-late, Glazier, and Kent varieties (Figure 2f). On the other hand, it was invisible in Alphonso, Zill, Brooks, Sensation, Bewerly, VSB, Amélie, Springfield, Lippens, Francis, Mangot vert, Mangot sabre, Valencia, and Dixon (Figure 4p).

The point to stylar scar (PCS) character appears weakly in Keitt, Dixon, Miami-late, Springfield, VSB, Bewerly, Glazier, Sensation, and Kent, with Kent as a control (Figure 4a). In the varieties Alphonso, Zill, Brooks, Amélie, Mangot vert, Lippens, and Valencia, it presented an average appearance (Figure 4-p). On the other hand, it appears strongly in Francis and Mangot sabre (Figure 4r).

DISCUSSION

The analysis of the qualitative leaf characteristics of the 18 mango tree varieties enabled their classification based on the shapes of the blade, the leaf base, and the top of the leaves. This variation is likely linked to the genotypic differences among these mango tree varieties. Similarly, Rymbai et al. (2014) attributed variations in leaf characteristics of different varieties to genetic variability and environmental effects. These results are supported by the findings of Syed et al. (2019). The leaf characteristics observed in mango tree varieties complement those reported by Vieccelli et al. (2016) for the Imbu cultivar. They described the leaves of the Imbu cultivar as lanceolate, with entire margins, and an acute base and apex of the blade. This study contributes additional information to the knowledge of various mango tree varieties. Joshi et al. (2012) reported similar results regarding leaf identification criteria for mango varieties in India. Ultimately, training various stakeholders in the mango sector on variety identification would facilitate the preservation of varietal purity and the valorization of mangoes in Burkina Faso.

Concerning the characteristics of the fruits, the results obtained for the 18 mango tree varieties will serve as a basis to further refine the criteria for variety identification based on the fruits. The work of Passannet et al. (2017) confirmed the physical characteristics of the Kent, Keitt, Brooks, Amelie, Lippens, Glazier, Bewerly, Zill, Miami-late, Springfield, and Valencia varieties studied. Likewise, according to Joshi et al. (2012), small-sized varieties may not be appreciated in the market.

Small size could be applicable to varieties such as Mangot vert, Mangot sabre, Alphonso, Sensation, and Dixon, which are characterized by their petite dimensions. Varieties currently favored by consumers are those that

Figure 4. Qualitatives characteristics of the fruits of 18 varieties of mango tree.

are colorful, firm, and possess a distinctive taste (Telemans, 2012). Indeed, varieties like Miami-late, Zill, Springfield, Glazier, Sensation, Keitt, and Kent are not only colorful but are also highly appreciated by consumers (Telemans, 2012). Limbongan et al. (2016) also reported various ripe fruit colorations (green, yellowish-red, greenish-yellow, red, reddish-yellow, greenish-red, orange-yellow, yellowish-green, light yellow, orange, yellowish-orange, yellow, and greenish-orange) across thirteen mango cultivars. This preference attests to the superior quality of these fruits for processing and consumption. Consequently, Benevides et al. (2008) noted that consumers tend to favor red and pink mangoes, a choice observed both in national and international markets. SIIM (2018) reported that, to comply with marketing standards, mangoes should be at least 30% colored, with a tolerance of 10% less colored fruit per carton.

For the consumption of fresh mangoes, in addition to mechanical or biotic damage, characteristics such as flavor, color, size, and general appearance of the fruit are also considered (Butac et al., 2012). According to ASEPEX (2016), the commercialization of mangoes depends on the consumption characteristics of European

markets. Various mango characteristics, including low fiber content, high fruit length, width, thickness, and weight, as well as high pulp content, play a crucial role in determining market viability (Crane et al., 2017). Therefore, a biochemical analysis of these varieties would enhance their marketing and transformation, particularly for those with higher pulp weight (Coral and Escobar-Garcia, 2021; Ledesma, 2018).

Conclusion

This study aimed to identify the distinctive characteristics of 18 mango tree varieties at INERA/Farako-Bâ. At the end of the study, 22 morphological characters were collected, including 18 qualitative and four quantitative parameters. These attributes facilitated the grouping of the varieties into three major groups based on the shape of the leaf blade (oblong, elliptical, and oval). Similarly, a significant variability was observed between varieties for the qualitative characteristics linked to the physiological maturity of fruits. Due to the results obtained, it is necessary to popularize these mango varieties to optimize mango production.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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