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Genetic Performance of Local Mango (*Mangifera indica* L.) Cultivars in Burkina Faso

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Abstract

The mango tree is a perennial plant of considerable socio-economic importance in arid and semi-arid zones. Nowadays, mango trees die on orchards due to desiccation. The general objective of this study is to characterized local cultivars used as rootstocks in Burkina Faso. To this end, the cores of four mango rootstock cultivars were collected from two agroclimatics zones. The experience followed a completely randomized Fisher block design. Observations and measurements were carried out on 104 days after sowing (DAS). As a result, there are similarities between Mangot vert and Mangot guina cultivars, and between Mangot sabre and Maiduguri. More, Mangot vert cultivar has the heaviest seeds (12.34g±3.52). The highest emergence rate (100%) was obtained by both cultivars Mangot vert and Mangot guina. Among these mango cultivars, Mangot vert had the heaviest seeds and germinated more clones with an average of four clones per core. It was followed respectively by Mangot guina (3 clones), Mangot sabre (3 clones) and Maiduguri (2 clones). The clones generally emerge after the zygotic seedlings have emerged with smaller sizes and neck diameters than the latter. In terms of seedling sizes and collar diameters, Mangot vert clones have the highest mean sizes and collar diameters of 14.94 cm±3.31 and 5.20 mm±0.72 respectively. They are respectively followed by Mangot guina (13.4cm±2.1 and 4.65 mm±0.43), Maiduguri (12.89 cm±1.2 and 4.60 mm±0.6) and Mangot sabre (12.38 cm±2.32 and 4.42 mm±0.56). In view of these results, mango rootstocks clones are the best plants for grafting in Burkina Faso.

Keywords: Cultivars; Clones; Rootstocks ; Mango; Burkina Faso.

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1. Introduction

The mango tree, *Mangifera indica* L., belongs to the Anacardiaceae family and is native to northern India near the Himalayas [1]. It is one of the most widely planted fruit trees in tropical and subtropical regions [2]. In Burkina Faso, the main mango production areas are located in the west of the country, particularly in the provinces of Kénédougou, Comoé, Houet and Léraba. The fresh mangoes during the 2022 were estimated at 102,211 tonnes [3]. As a result, the mango has become the most important fruit crop in the country, and is therefore considered to be the "leading national fruit". Among the many cultivars of mango found in orchards, six are the most abundant. These are Amelie, Brooks, Kent, Keitt, Lippens and Springfield cultivars [4]. Burkina Faso is covered by a large orchard in the west and south-west, with annual production of between 160,000 and 200,000 tonnes [5]. These cultivars are made up of ordinary cultivars (polyembryonics) and breeded cultivars (monoembryonics) [6]. Only the ordinary cultivars (Mangot vert, Mangot guina, Maiduguri and Mangot sabre) can be propagated by sowing. Biochemical analyses have shown that the Mangot vert and Mangot sabre cultivars have a higher water content than the breeded cultivars Lippens [7], hence their ability to adapt better to Burkina Faso's agro-climatic conditions.

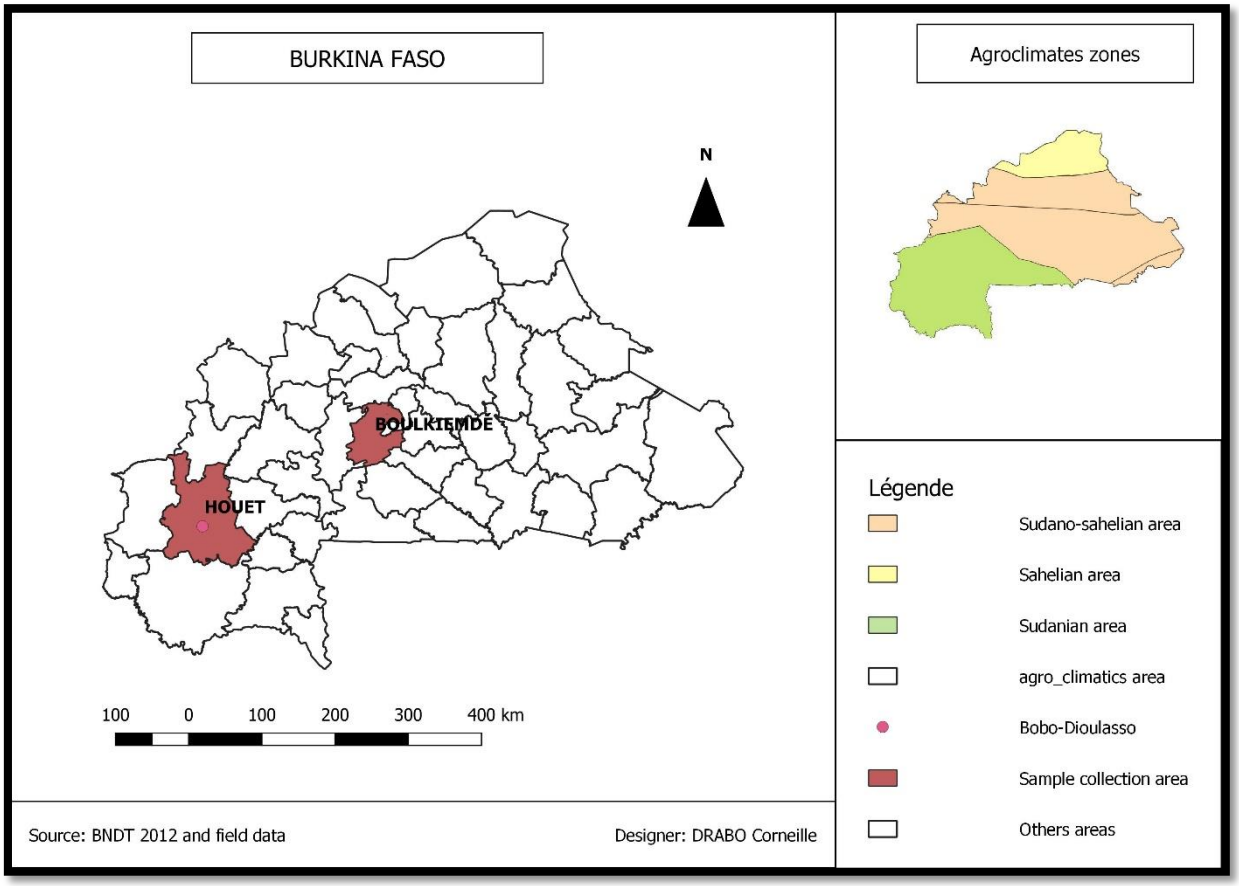
Despite of their adaptability to the agro-climatic conditions of Burkina Faso, their genetic performance is not sufficiently well known. The main objective is to characterized local cultivars used as rootstocks in Burkina Faso in order to increase mango production and avoid it dessication in orchards.

2. Material and Methods

2.1. Presentation of the Study Site

Mango cores of the Mangot guina cultivar were collected at Boulkiemde province in the sudano-sahelian zone and those from Mangot vert, Mangot sabre and Maiduguri cultivars were collected in Houet province in the sudanian zone of Burkina Faso. Experience was conducted at the institut of environmental and agricultural research (INERA/Farako-Bâ) and at the agricultural farm of Kouentou. These sites both located in the in Houet province (Fig 1).

Fig-1. Location of the INERA/Farako-Bâ research station

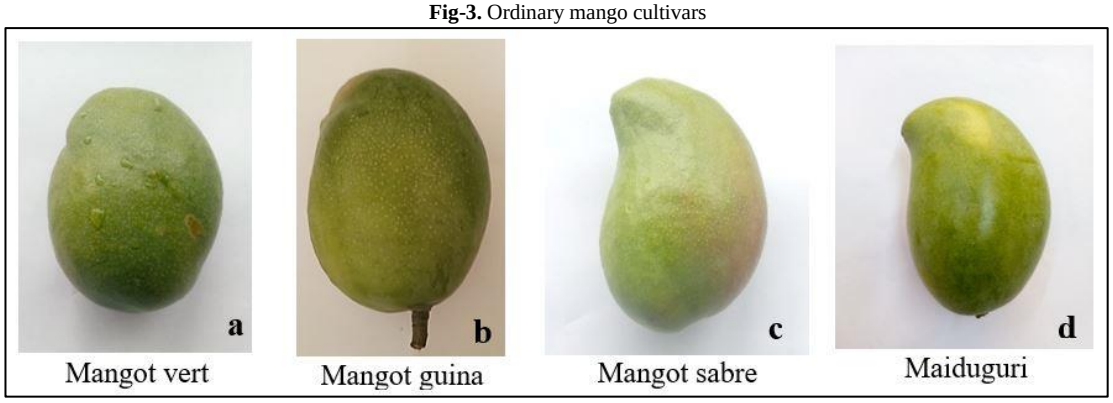


2.2. Plant Material

The plant material consisted of the seeds (Fig 2) of four ordinary mango cultivars. The mangoes were picked from mango trees that had previously been identified and sorted. These different mango cultivars (Fig 3) are polyembryonics with a juvenile period of 5 years and are adapted to rainfall zones of 800-900 mm rainfall/year. These polyembryonic cultivars are used as rootstocks for propagating commercial mango cultivars in Burkina Faso.

Fig-2. Seed of mango cultivars

Fig-3. Ordinary mango cultivars



Legend: a: Mangot vert; b: Mangot guina; c: Mangot sabre; d: Maiduguri.

2.3. Technical Equipment

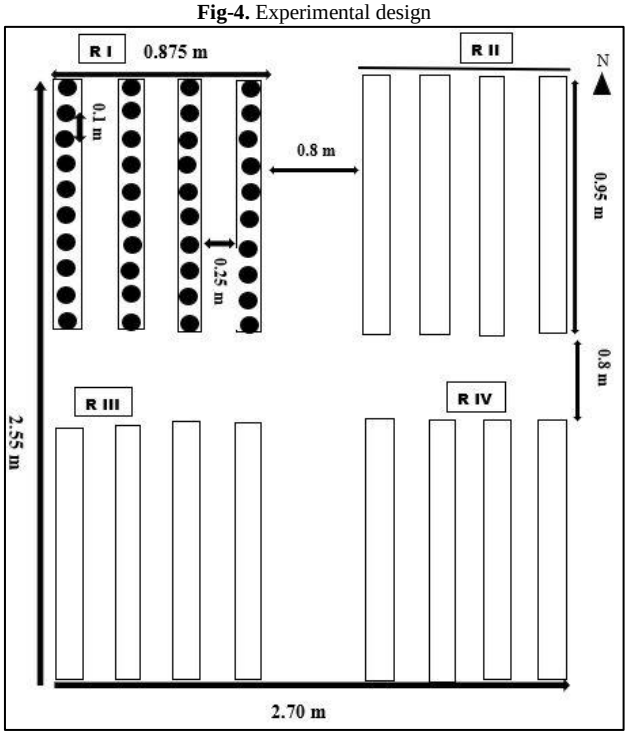
The technical equipment used to set up and maintain the trial consisted mainly of :

- String and stakes to demarcate the nursery;
- Metric tape for measuring plant heights;
- Calipers for measuring plant diameters;
- A 50 kg bag to collect the mango pits;
- A daba, a pickaxe and a shovel to prepare the nursery.

2.4. Experimental Design

The experimental design for this study is a completely randomized Fisher block with four replications. Each replicate consisted of four lines 0.25 m apart, with one line per cultivar. On each line, ten cores, each 0.10 m apart, were sown. The replicates are 0.80 m apart. The plot used covers an area of 6,885 m^2, with a length of 2.70 m and a width of 2.55 m (Fig 4).

Fig-4. Experimental design



2.5. Nursery Installation

Before nursery installation, the almond masses were taken. The nursery was installated by ploughing the area thoroughly. The seedlings were then sown by hand to a depth of 5 cm to encourage good emergence. After three and a half month, once there was no more emergence, the seedlings of the cultivars were measured. The first seedling to emerge from a nucleus was designated as the zygotic seedling and the seedlings that grew one by one from the same nucleus over the following days were designated as the clones. However, only the clones were counted and measured. This choice was made in relation to the work of Barua [6], which states that polyembryonic cultivars ave several embryos, one of which may be zygotic and the others clones.

2.6. Data Collection Methods

The quantitative data considered are: [Seeds mass; emergence rate; number of clones/cultivar; survival rate of clones/cultivars; collar diameter of plants, tigelle height and brix degre]. The qualitative data considered are the colour; presence of neck ; presence of sinus ; deaph of sinus ; stalk cavity ; shape of ventral shoulder ; shape of fruit and presence of fiber. We used the mango descriptor proposed by the International Union for the Protection of Plants [8] for characterization.

2.7. Statistical Analysis of Data

The data collected was entered using Microsoft Office Excel version 2016. The data were subjected to an analysis of variance (ANOVA) using XLSTAT Version 2016.02.28451. Means were separated at the 5% threshold using the Newman-Keuls test. The dendrogram is designed with Darwin version 6.0.21.

3. Results

3.1. Morphological Traits and Brix Variations of Mango Fruits

Table 1 shows differents characteristics of four ordinary mango cultivars. This table shows that cultivars have common qualitatives characteristics. These are Mangot vert and Mangot guina, Mangot sabre and Maiduguri for certains characteristics. Fiber content is higher in Mangot guina than in Mangot vert, Mangot sabre and Maiduguri.

Table-1. Characteristics of four ordinary mango cultivars

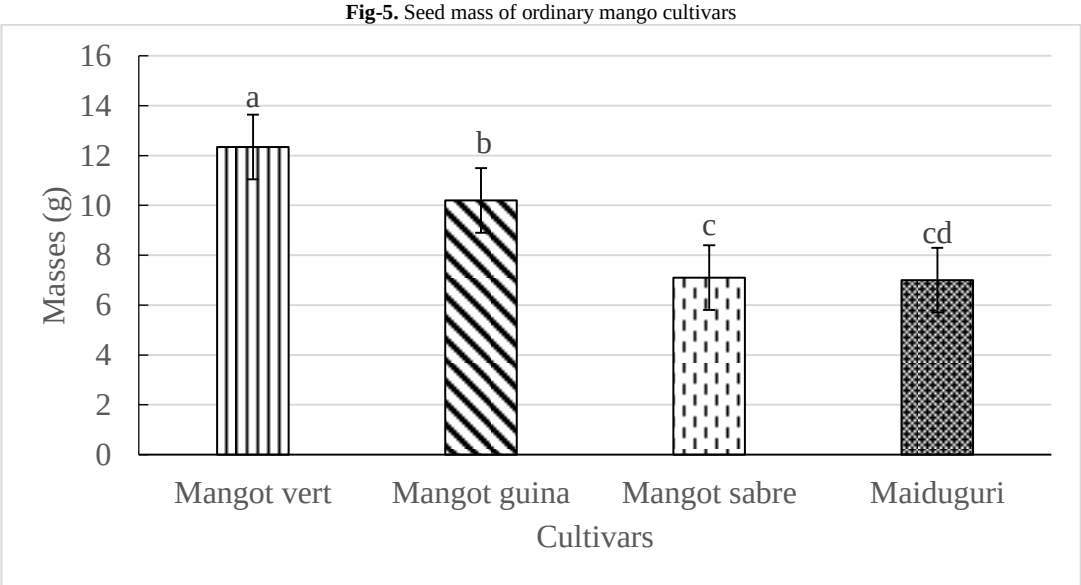
Cultivars	Colour	Pr.n	Pr.sin	D.sin	StCa	SVS	S.fruit	Pr.Fib	TSS(°B)
Mangot vert	-	-	-	-	-	rounded upward	Rounding	Important	20
Mangot guina	-	-	-	-	-	rounded upward	Rounding	Very important	22
Maiduguri	-	-	+	+	-	rounded upward	Extended	little	14
Mangot sabre	-	-	+	+	-	rounded upward	Extended	little	15

Legend : *- : Absent ; + : present ; Pr.n : presence of neck ; Pr.sin : presence of sinus ; D.sin : Deaph of sinus ;St.Ca : Stalk Cavity ; SVS : Shape of ventral shoulder ; S.fruit : Shape of fruit ; PrFib : presence of fiber, °B : Brix degre.*

3.2. Seed Mass of Mango Cultivars

Fig 5 shows the seed mass of the four common mango cultivars. From this table, it can be seen that Mangot vert cultivar has the heaviest seeds (12.34g±3.52). It is followed respectively by the Mangot guina (10.22g±2.32), Mangot sabre (7.10g±3.13) and Maiduguri (7g±2.45) cultivars. Analysis of variance showed a very highly significant difference between mango cultivars at the 5% threshold.

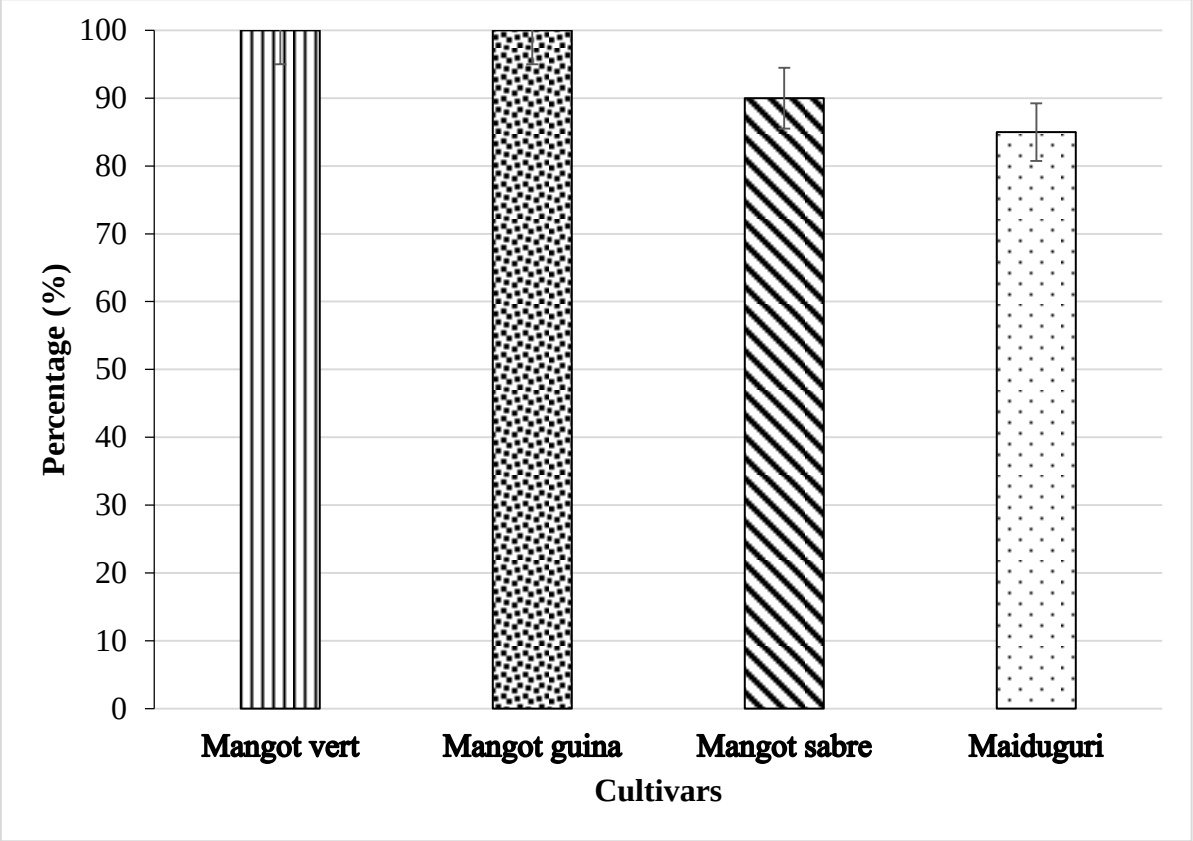
Fig-5. Seed mass of ordinary mango cultivars



3.3. Seedling Emergence of Mango Cultivars

Fig 6 shows the seedling emergence parameters for ordinary cultivars. From this figure, it can be seen that seedling emergence time averaged 27 days after sowing. In addition, the emergence rate was 100% for the Mangot vert and Mangot guina cultivars, 90% for the Mangot sabre cultivar and 85% for the Maiduguri cultivar. The time to last emergence was 105 days after sowing (DAS).

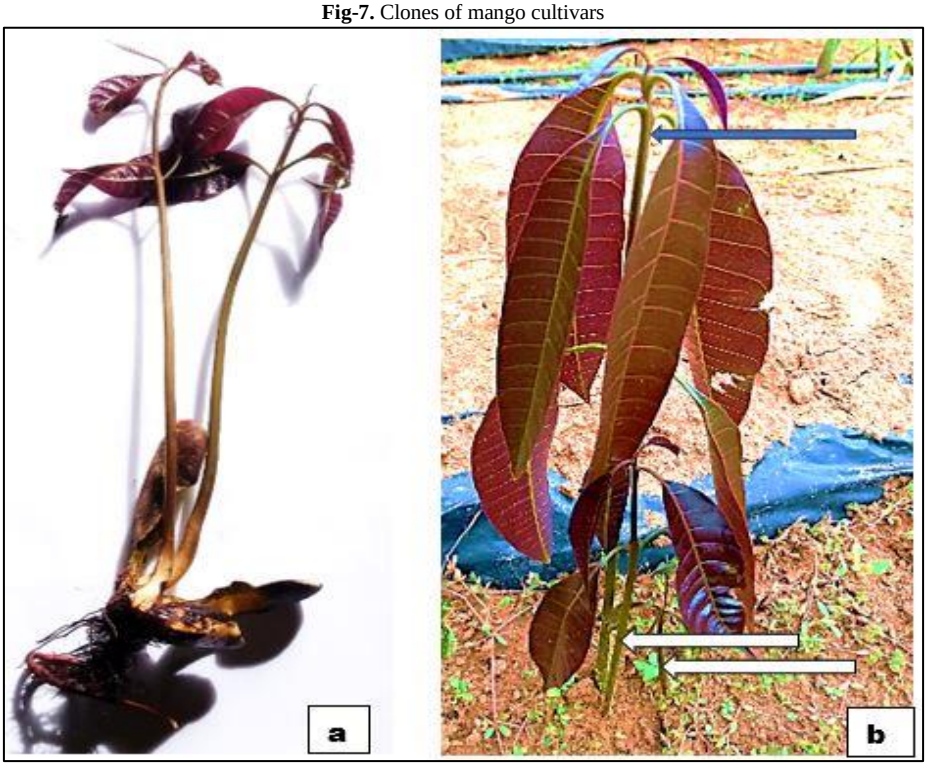
Fig-6. Seedling emergence rate of mango cultivars



3.4. Clones Identification Per Cultivar

As result, all of cultivars are polyembrionics (Fig 7-a). The average number of clones obtained differs to cultivars (Fig 7). The Mangot vert cultivar obtained the highest average number of clones (4). It was followed by the Mangot guina and Mangot sabre cultivars, which obtained an average number of clones equal to 3. However, the Maiduguri cultivar obtained the lowest average number of clones (2). Zygotic plants emerged but were not counted (Fig 7-b).

Fig-7. Clones of mango cultivars

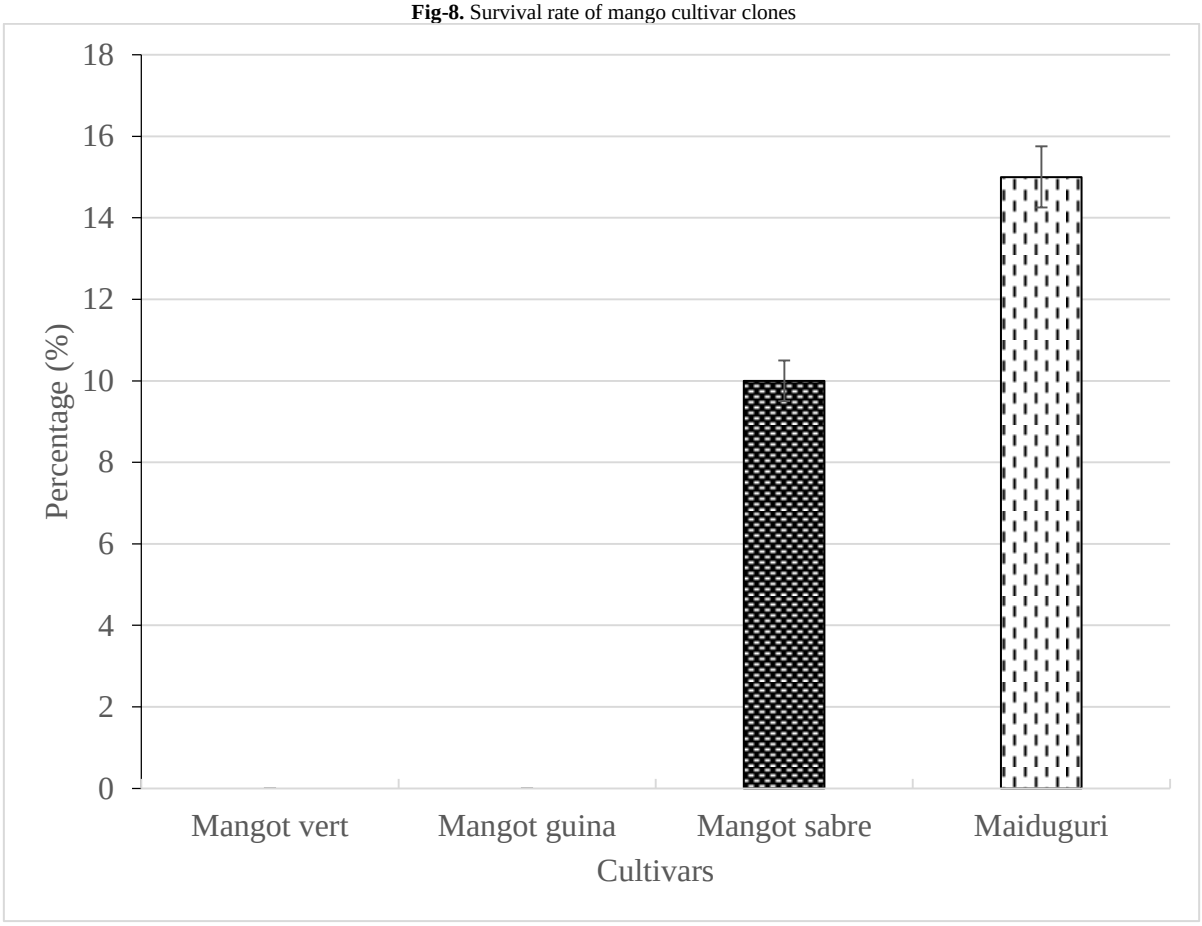


⇒ Zygotic plant
⇨ Clones

3.5. Survival Rate of Clones by Cultivars

Fig 8 shows the survival rate of the different mango cultivars sown. The results showed that the Mangot vert and Mangot guina cultivars recorded no mortality. On the other hand, the Mangot sabre and Maiduguri cultivars recorded 10 and 15% mortality respectively.

Fig-8. Survival rate of mango cultivar clones



3.6. Agro-Morphological Parameters Measured

Table 2 shows the variation in agro-morphological parameters (collar diameters and plant heights) of the different ordinary mango cultivars. The analysis of variance showed a very highly significant difference at the 5% threshold between cultivars. From this table, it can be seen that the Mangot vert cultivar obtained the highest values for collar diameter (5.20 mm ±0.72). It was followed by the Mangot guina and Maiduguri cultivars, which had mean collar diameters of 4.65 mm ±0.43 and 4.60 mm ±0.6 respectively. However, the Mangot sabre cultivar had the lowest collar diameters value (4.42±0.56 mm). In terms of average plant heights, the Mangot vert cultivar also obtained the highest height values (14.94 cm ±3.31). It was followed by the Mangot guina and Maiduguri cultivars, which had mean heights of 13.40 cm ±2.1 and 12.89 cm ±1.2 respectively. However, the Mangot sabre cultivar also had the lowest height value (12.38 cm ±2.32).

Table-2. Variation in mean heights and mean diameters at the seedling collar of mango cultivars

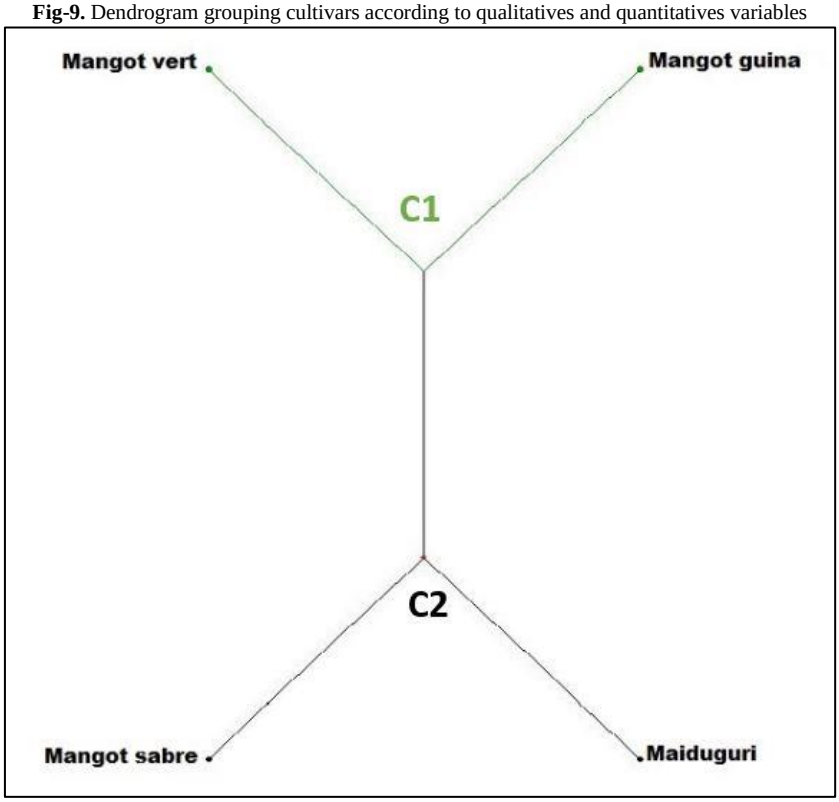
Cultivars	**Average collar diameters (mm)**	**Average plant heights (cm)**
Mangot vert	520^{a} ±0.72	14.94^{a} ±3.31
Mangot guina	4.65^{b} ±0.43	13.40^{b} ±2.1
Maiduguri	4.60^{c} ±0.6	12.89^{c} ±1,2
Mangot sabre	4.42^{d} ±0.56	12.38^{d} ±2.32
ddl	159	159
Pr > F	**< 0.0001**	**< 0.0001**
Signification	**THS**	**THS**

NB: The values of figures bearing the same letters in the same column are statistically equivalent at the 5% threshold (Newman Keuls test) for the agronomic parameter under consideration. The values in brackets indicate the standard deviations between the different replicates.

3.7. Structuring of Mango Fruits According to All Parameters

The dendrogram showed the distribution of four cultivars into two classes (Fig 9). The first class (C1), represented by Mangot vert and Mangot guina. The morphological parameters are the same excepted the fiber content which the quantity is very important in Mangot guina than Mangot vert. The second class (C2) comprised Maiduguri and Mangot sabre. The morphological parameters are also the same.

Fig-9. Dendrogram grouping cultivars according to qualitatives and quantitatives variables



4. Discussion

About morphological traits and brix variations, mango fruits showed similarities bethween cultivars in pairs. These similarities could be explained as the influence of environmental factors on their genotypes. Under the influence of the pedoclimatic conditions of the sahelian area, the Mangot vert genotype could mutated into Mangot guina since it's not yet identified anywhere. In the case of Mangot sabre and Maiduguri, their ressemblance could be explained by the fact they were introduced from the same localities, since there are identified in Chad and even bear the name of localities such as Maiduguri in Nigeria and Kassai (Mangot sabre) in Congo Republic Democratic [9]. The result of seeds mass measurements indicates that the seed of Mangot vert cultivar is able to contain several fertile embryos compared with the others. Furthermore, previous results from the work of Martínez, *et al.* [10] confirm that the mass of the seed is an indicator of the number of embryos it contains. Furthermore, Weiher, *et al.* [11] revealed that seed mass is related to the allocation of individuals to reproduction and the developmental success of seedlings after germination. According to Passannet, *et al.* [9], this genetically determined reproductive trait characterises the vigour and viability of a seedling. All ordinary mango cultivars have this trait and this would justify the fact that they are used as rootstocks and Mangot vert as the best.

The results of seedling emergence of ordinary mango cultivars were satisfactory. These results can be explained by the good quality of the cores of these different cultivars. In fact, the sorting of the seeds had an influence on the good emergence of the seedlings. In addition, the absence of dormancy in mango seeds [12] would explain this good emergence if the seeds were sown immediately after harvesting. This result is more satisfactory than that reported by [13] on the average emergence of Mangot vert and Mangot sabre seeds in nurseries. The time to last emergence (104 days after sowing) recorded also confirms that of Drabo, *et al.* [13]. Cultivar emergence results showed that Mangot vert and Mangot guina recorded l00% emergence. These results could be explained by the fact that the nuclei of the Mangot vert and Mangot guina cultivars contain many more "fertile" embryos than the nuclei of the other cultivars. The similarity in emergence parameters between the Mangot vert and Mangot guina cultivars could be explained genetically.

The results showed that mango cultivars emerged from clones with a different number depending on the cultivar. In fact, mango cultivars are polyembryonic and have seeds with a zygotic embryo and several nucellar embryos [14]. From these nucellar embryos emerge clones that will have the same genetic material as the mother plant. From this observation, the selection of clones of the various rootstocks makes it possible to combat parasitic attacks on mango trees. These results are in agreement with those of Zakaria, *et al.* [15] who reported between 2 and 6 clones per seed in Sala and Tangkai Panjang mango cultivars. The results of the various measurements show that Mangot vert cultivars have greater average heights and average diameters at the crown than the other cultivars. This could be explained by the fact that Mangot vert seeds have larger embryos than those of the other cultivars. In

addition, Mangot vert clones grow very quickly after emergence compared with those of the other cultivars. Mangot vert seedlings (clones) are therefore best recommended for grafting.

5. Conclusion

The present study made it possible to characterized local cultivars used as rootstocks in Burkina Faso. The results showed that the cultivars have similarities in pairs. Mangot vert and Mangot guina cultivars obtained a higher emergence rate (100%). In addition, the Mangot vert cultivar had the heaviest seeds and obtained more clones (4) than the other cultivars. In terms of agro-morphological parameters, the clones from the Mangot vert cultivar still obtained heights and mean collar diameters that were significantly higher than those of the other cultivars. These clones, which are derived from the germination of embryonic sac tissues, are the best because they are as resistant as the mother plants. Selection of clones from ordinary mango cultivars could help to improve mango productivity.

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Project administration : Jacob SANOU, Windpouiré Vianney TARPAGA, Mahamadou SAWADOGO.
Supervision : Jacob SANOU, Windpouiré Vianney TARPAGA, Mahamadou SAWADOGO.
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Writing – review & editing : Corneille DRABO, Zara Soutonnoma NIKIEMA, Jacob SANOU, Windpouiré Vianney TARPAGA, Mahamadou SAWADOGO.

Competing interests

Authors have declared that no competing interests exist.

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