TYPOLOGY OF SHEA TREES (Vitellaria paradoxa) USING QUALITATIVE MORPHOLOGICAL TRAITS IN CÔTE D’IVOIRE

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Received 02 April, 2009.
Accepted 20 June, 2009.

Abstract

The shea tree (Vitellaria paradoxa C.F. Gaertn) is a multi-purpose tree daily used by rural African communities. The present study aimed at investigating the level of morphological variation and then to propose a varietals classification using discriminative descriptors. Morphological observations were related to 13 traits, studied on 124-300 trees selected from shea experimentation station localized in Tengrela. The result showed that there was a variation within the shea trees related to qualitative morphological traits studied. Four shapes of the mature tree (ball or spherical, broom, sunshade or broadly pyramidal and erect), 5 shapes of the fruit (round, reversed pear, ovoid, fusiform and ellipsoid), 4 phenotypes of the nut colour (clear brown, dark brown, greyish brown and blackish brown), 3 phenotypes of the colour of the budding fruits and leaves (green clear, purplish and reddish) and 3 pace at small branch have been observed. A total of 9 (5 morphological and 4 physiological) varieties have been described. The distinction of morphological varieties was essentially made on the basis of the shapes and the sizes of the fruits and leaves. However, the distinction of physiological varieties was based on the maturation period of the fruits.

KEYS WORDS: Côte d’Ivoire – Morphological traits- Shea tree – Varieties- Variation
INTRODUCTION

The shea tree (Vitellaria paradoxa C.F. Gaertn) is a multi-purpose tree daily used by rural African communities. The species belongs to Ebenales order which contains 600 species distributed in 50 genera (Leroy, 1982; Guignard, 1986). The family Sapotaceae to which shea belongs contains 25 genera representing 50 species. Botanists, agronomists and farmers have made varieties descriptions using morphological and phonological traits (Chevalier, 1943; Okullo et al., 2004; Diarrassouba et al., 2007b). They reported that 3 varieties (mangifolium, poissoni and niloticum) are distributed in each specific ecological zone where shea trees grow. According to these authors, mangifolium variety is found notably in the North-Soudanian zone in Mali, in Côte d'Ivoire and in Burkina Faso. The poissoni variety is present in Benin and in Ghana and the niloticum variety in East Africa. Domestication actions undertaken on shea in Ghana and Uganda showed that hand pollination increased the number of fruits set in crosses between trees whilst selfing produced no fruit set. But, all cross-pollinated flowers produced fruits. Thus confirming that the trees are largely out crossing (Yidana, 1991 ; Okullo et al., 2003). But since colonial times, little studies have been led on shea varietal description using qualitative traits. It is also difficult to distinguish varieties at the field.

In the same way, molecular markers (ALFP and microsatellites) have been used for the assessment of the species diversity. Less variation has been observed between shea tree population (Lovett and Haq 2004; Bouvet et al., 2004; Fontaine et al., 2004). On the biochemical level, the works of Maranz et al., (2004) showed an important variability of some physical and chemical properties of shea kernel and shea butter within shea trees populations from West and Central Africa. The morphological describers have already been used on other savannas species. Different phenotypes have been identified within Parkia biglobosa populations (Ouédraogo, 1995) and within Deutarium microcarpum population (Kouyaté and Van Damme, 2002) and on Andasonia digitata (Assogbadjo et al 2005; 2006) using fruit shape and other related traits measured on the fruits and the leaves. However, in spite of the acquired achieved on quantitative and molecular characterization level, little studies have been led on shea varietal description using qualitative traits since colonial times. This present study aimed at investigating the level of morphological variation and then to propose a varietals classification using morphological and physiological traits.

NATURAL DESCRIPTION OF THE PRODUCTION ZONE

Côte d'Ivoire is located in West Africa, between 4° 30' and 10° 30' North latitude and 2° 30' and 8° 30' of West longitude and belongs to tropical area. The country extends on a few 322 462 km². According to climatic factors and vegetation variations, savannas of the North of the Côte d'Ivoire where shea trees grow have been subdivided in two main zones (Figure 1). Sudanian savanna beyond the North limit, the line passing to Tengrela, Boundiali, Ferkéssédogou Korhogo, Bouna and the North of Odienné departments. This part corresponds to the main production zone of shea. The second zone is a sub-sudanian savanna with for North limit, the line passing to the south of Odienné departement, Katiola, Bondoukou, Bouake and Touba departments. This part corresponds to the transition production zone of shea.

MATERIAL AND METHODS

Plant material

The study was carried out in shea parkland of Tengrela department. The study site (24 hectares), were selected on the basis of two criteria: land use (fallow and forest stands) and a relatively high density of adult trees. Since 1996, the fallow parkland has been the main experimentation station for shea research program. The portion of this parkland covered by this survey includes 619 trees with an average density of 25 trees by hectare (Figure 2).
Data collection

The descriptors analyzed in this survey were retained after field work exploratory observations. The present investigation was carried out in October 2000 and July 2002. It took into account 2 shea phenological cycles in Côte d’Ivoire (first cycle: October 2000 – August 2001 and second cycle: October 2001 – August 2002). A total of 14 descriptors were analysed on the trees, the branches, the fruits and on the leaves. Observations were noted on a morphological characterisation chart carrying the number of the parcel, the tree and the descriptors analyzed (annexe 1). This was done on the basis that qualitative characters are more reliable and easily usable for the morphological variability studies on a large scale (Guira, 1997; Diarrassouba et al., 2007a et b). The geographical coordinates of the parkland and each shea tree were taken using a Geographical Positioning System apparatus.

Describers analyzed on mature trees

The canopy shape of shea tree and branching pattern has already been described (Ruyssen, 1957; ORSTOM, 1980; Letouzey, 1982; IPGRI/INIA, 2006). These characters were studied on 300 trees chosen in the parkland respected a least of 25 meters between the trees selected. The small branch takes birth from the secondary branch. Generally, such branches are all looks in the same direction at shea trees. The colour of the young leaves was observed at the beginning of the foliation phase before the leaves blossoming (IPGRI/INIA, 2006). However, the colour of the mature leaves was appreciated when the leaf was entirely formed (one year old). Leaves apexes were identified according to described shapes in the literature (IPGRI/INIA, 2006). Different phenotypes and the code associated to the character observed on the trees and the leaves are mentioned in table 1.

Describers analyzed on the fruits

To minimize the loss of fruits, shea trees analyzed for the fruits characters were reduced to 124 trees. During ten days, all fruits fallen the eve have been collected under each shea tree kept for the survey. Among the collected fruits, 30 fruits have been selected without discount and the pulp has been removing. The dominant colour of the seed of 30 newly depulped fruits was noted (IPGRI/INIA, 2006). The characters analyzed on fruits were observed on the 124 trees sampled. The taste of the fruit was appreciated in an empiric manner. During ten days, all fruits fallen the eve have been collected under each shea tree kept for the survey. Among the collected fruits, 30 fruits have been selected without discount and tasted by 3 tasters (a taster was chosen among the 3 workmen used for the collection of the fruits and the surveillance of the experimental parcels. A taster was chosen among the women and the third taster was chosen among passers-by. Each ‘taster’ tasted 10 fruits and the taste was noted. The tasting of the fruits began at least 10 days after the beginning of the fall of the fruits and ended 10 days.

Different phenotypes observed and the code associated to the character analyzed on the fruit and the seeds are mentioned in table 2.

Abort fruits is destitute of almond. This phenomenon has also been studied on 326158 collected fruits. The number of fruits aborted and the number of fruits containing at least a nut has been deducted and the percentages have been calculated for every type of fruit. 1, 2, 3 or even 4 nuts were often observed in some fruits. They are composed fruits. The number of nuts per fruit was studied on 326158 fruits collected. The numbers of fruits containing 1, 2, 3 and 4 nuts were evaluated and their percentages were calculated for every type of fruits.

The fruiting season type was observed after analysis based on fruit falling rhythm. The beginning and the end of the fall of
the fruits was noted over a two year period. The trees analysed were marked according to the fruit maturation period. From the daily production, curves describing the evolution of the fruits falling to the ground were drawn for characteristic trees of every determined category using Excel software for Windows.

Data analysis

Shea population structuring was led by a Hierarchized Ascending Classification (AHC). The principle of hierarchical tree construction was based on an estimated similarity relation between observations from the averages pondered of the Pearson coefficient while applying the Ward algorithm method (Morineau and Aluja-Banet 1998). Some curves have been drawn to show the evolution of shea fruits fall rhythm. Where necessary, pictures have been used to put in highlight some phenotypes. The GPS data have been analyzed on Arc view GIS 3.2 software and the plan of the park has been conceived using the same software. All these analyses were achieved using XLSTAT 2007.6 version software, Copyright 1995-2007, a mark deposited of AddinSoft.

RESULTS

Variability on characters of mature trees and branches

Canopy shape

Four forms of the tree shape were identified. Phenotypes observed were unequally distributed in the parkland studied. One hundred sixty trees (53.20 %) had the broom shape, 66 trees (22 %) had the ball or spherical, 55 trees (18.40 %) had the strain and 19 trees (6.40 %) had the sunshade shapes. Different phenotypes identified are presented on figures 4, 5, 6 and 7. The trees which had ball shapes presented convex foliage. The broom shaped trees were characterised by a spacing of the secondary branches in V and a horizontal superior area. The sunshade shape trees distinguished itself from the broom shape ones by the length of the secondary branches that was shorter and the foliage superior area which was oblate ellipsoid. About strained or tapered shapes, every branch had orthotropic growth. The trunk was generally very high.

Branching pattern

Generally, at shea trees, branches are all looks in the same direction. In this survey, three main phenotypes were identified from branching pattern. 58.33 % of the trees sampled carried some secondary plagiotropic branches, 26.67 % of the trees had secondary branches oriented in a horizontal manner and 15 % of the trees had strained or erected branches.

Variability of the characters of the fruits and nuts

Seed coat and fruit colour

Shea mature seeds coat colour is homogeneous within the same tree. Field observations led to the identification of 4 phenotypes for shea nut colour. Nut colour varied from clear brown to the blackish brown (Figure 8). These phenotypes were observed in varied proportions. 71.5 % of the shea trees analysed had a dark brown phenotype, 18 % of the trees had the clear brown colour, 3.50% of the trees had greyish brown nuts while 6.40 % of them had blackish brown nuts.

Three phenotypes were identified for immature fruits colour character. These phenotypes were distributed in varying
proportions in the shea populations. 48.33 % of the trees presented the purple phenotype, 27.67 % of the trees gave young fruits with a green clear colour and 24 % of reddish colour. Immature fruit colour varied from clear green through purple to red (Figure 9).

**Fruit's shape, pubescence and taste**

Five phenotypes were identified variable proportions for the fruit shape in this shea parkland. 45.30 % of shea trees sampled had ovoid shaped fruits, 41.80 % round, 5.80 % and 3.70 % had reversed pear fruits. Phenotypes observed in this survey are presented on figures 10, 11, 12, 13 and 14.

Two phenotypes have been identified for fruit pubescence in variable proportions. Sixty two per cent of the shea trees sampled contained none pubescent mature fruits while 38 % of the shea trees contained pubescent mature fruits.

Three categories of fruits were identified for pulp taste, 56.25 % of the shea trees analysed, produced flavourless or insipid fruits, 31.25 % of the trees produced sweet fruits while 12.50 % produced very sweet fruits.

**Number of seed per fruit**

Composed fruits with 2, 3 or 4 nuts were observed during our field work (Figure 15). Field observations carrying on a sample of 125 trees revealed two categories of trees shea according to the number of seed per fruit. The first group contains 67 % of shea trees at which composed fruits percentage is lower to 10% [. The second category is composed of 33 % of the trees selected and which composed fruits rate varied between] 10- 37% [. Likewise, observations carried on the 326158 fruits collected gave composed fruits in variable proportions. 297913 fruits with one nut (91.34 %); 22016 fruits with 2 nuts, (6.75 %); 4631 fruits with 3 nuts (1.42 %) and 1370 fruits with 4 nuts (0.49 %) per fruit.

**Fruiting season type and fall rhythm of the fruits**

The rhythm of fruits’ daily fall of 124 trees was evaluated. The trees have been classified into four categories according fruiting season and fruits fallen rate. The fruits of 26 (20.96 %) trees were early maturing trees. The fall of these fruits generally starts in April and ends in mid May (Figure 16). About seventy two percent of shea trees sampled are mid-season trees. The fall of the fruits of these trees starts in May and ends in June (Figure 17). However, in these trees category, there are some trees which have maturity periods spread over the entire production time (Figure 18). This category production period spread over early, intermediate and late fruiting seasons. Nine trees (7.26 %) had a late production period. The fall of the fruits of these trees starts in mid May and ends in late July (Figure 19).

**Aborted fruits**

Three categories of trees have been identified according to the importance of abortive phenomenon. The abortion of the fruits is almost non-existent at 85.67 % of the trees sampled. The percentage of aborted fruits is indeed, between [0 and 1%] for these individuals. The phenomenon is rare at 6.45 % of the trees sampled. The proportion of these trees is included between 1 and 15%. The phenomenon is important at 8 % of the trees with a proportion understood between 15 and 79 %.

**Variability of foliar characters**

Three colours (light green, pink and red) were observed at young leaves (before the leaves blossoming) in variable proportions (Figure 20). They were 28.33 %, for light green; 46.66 % for pink and 25 % for the red one.
Also, three colours (light green, green and dark green) were observed at mature leaves (one year old) in variable proportions. The frequency observed for every phenotype was 18 %; 55 % and 27 % respectively for the light green, green and dark green phenotypes.

Three types of apexes (obtuse, retuse and acuminate) were observed. On the 300 trees analyzed for this character, 25 % carried margined or retuse apex, 43.33 % carried leaves with obtuse apex and 31.67 % of the trees carried acuminate apex.

**Structuring and varieties distinction**

The dendrogram obtained from the truncation at 0.50 of similarity allowed to distinguish two major phenotypic groups within the sample investigated trees. Meanwhile, the truncation at 0.41 of similarity, 5 phenotypic classes were distinguished (Fig. 3). The Wilks test applied with significance alpha = 0.05, and a P-value belonging 0.0001, permitted to disallow the null hypothesis of equality of 5 groups vectors. So, these 5 phenotypic groups represented morphological entities.

In this study, 5 varieties were described using morphological and 4 using physiological traits named 'variety 1, 2, 3, 4, 5, 6, 7, 8 and 9. The distinction of morphological varieties was essentially based on the shapes and sizes of the fruits and leaves.

Variety 1 was characterised by ovoid or oblong fruits, none pubescent to maturity, long leaves, light green young leaves and falling again branches.

Variety 2 was characterised by big, round, and pubescent fruits, depressed at the apex, large leaves and small strained branches.

Variety 3 had mean reversed pear fruits, small waved leaves, reddish young leaves and small strained branches.

Variety 4 was characterised by small round and pubescent mature fruits, lilac young fruits, small leaves, reddish young leaves and small horizontal branches.

Variety 5 was characterized by elongated and none pubescent mature fruits, long and large leaves green clear young leaves and small strained branches.

The distinction of physiological varieties was based on the fruits’ maturation period. Varieties 6, 7 and 9 were identified as having early, intermediate and late maturation periods respectively. Variety 8 had its maturation period spread out through the early, intermediate and late maturation periods.

**DISCUSSION**

This survey carried out on the variability and the discriminatory describers of shea was a preliminary step necessary to define shea resources characterisation strategies. Three and four phenotypes were observed respectively for the branch pace and the canopy of the mature trees. However, the diversity of intermediate canopy made difficult the distinction of the trees using this character. Indeed, the competition generated by the proximity of the other trees and especially the human's action for agriculture could have modified the canopy of the trees. Many previous descriptions of canopy shape have been undertaken. Round or spherical, spindle, umbrella or broom like crown shapes have been described (Ruyssen, 1957) and pyramidal, broadly pyramidal, spherical, oblong, semicircular and elliptical (IPGRI/INIA, 2006). In the same way, in some areas, it has been suggested that shape falls into distinct groups and is associated with particular phenological characteristics. In West Africa, three shapes for Subsparadoxa (spherical, umbrella shaped or intermediate with a crown radius (Ruyssen, 1957).
Schreckenberg (1996) classified shea trees in Bassila Benin, into erect and round types which showed correlation with lower and higher fruit yields respectively. According to Hall et al. (1996) both the main stem and the branches showed rhythmic growth, the branches being modular, and plagiotropic by opposition.

With respect to the young fruits colour, three phenotypes were distinguished (light green, pink and red). The observed theoretical frequencies were 27.5 % for the light green phenotype, 48 % for the purplish phenotype and 24.5 % for the reddish phenotype. These frequencies are statistically equal to the theoretical segregations observed in the setting of a mono hybridism whose character is governed by 2 alleles with intermediate dominance. In this case, the purplish phenotype could be an intermediate phenotype between the reddish and the green clear. Thus distinction based on the coloration of the immature fruits was clear. The distinction from the nut colour was also clear. However this last character is only observable after removing fruit pulp. Immature fruits therefore appeared simple for use in subsequent studies on a larger scale. Some previous studies have already made specific classifications using immature fruits and immature leaves in Burkina faso (Guira, 1997).

Five phenotypes were observed for fruit shape. They were round or globular, reversed pear; ovoid, ellipsoid and fusiform phenotypes. The shape of the fruit was very discriminative and was easily observable and was equally retained for use on a larger scale (Diarrassouba, 2000). The phenotypes observed seemed to have been categorised into two extreme phenotypes of the size of the fruit (small or big). Before these results, only 4 phenotypes had been described. Of the 4 that had already been identified, the round, ovoid and fusiform phenotypes are described at Ferkessedougou’s station in Côte d’Ivoire by Delolme (1947). In West Africa, the 4 phenotypes were described by Chevalier (1943). In the same way, the rounded phenotypes, reversed pear and ovoid were identified in Mali (Hall et al., 1996) and in Ghana (Pennington 1991). Yet, the composite fruit phenomenon influenced the shape. For example, during our study, fruits with 3 and 4 nuts each were recorded. Indeed, previous results showed that fruit shape and size may vary according to the number of seeds within (Yidana, 1991). There is usually one, less often two and rarely three seeds (Diarrassouba, 2000).

Aborted fruits were observed on a small number of trees. However, the phenomenon is far from being negligible because one noted that 30 to 35 % of the fruits aborted among the early and late trees. The lowest values of aborted fruits were recorded among the mid-season fruit trees. This situation can be justified by the high proportion (71.79 %) of the mid-season fruit trees that flower at the same time, encouraging cross pollination. On the other hand, very few trees were early or late maturing in nature. Nevertheless, the shea tree is preferentially an allogame plant. Long distances that separate the early and late maturing trees made cross pollination difficult.

The fruiting season type varied from a tree to another but was maintained per tree from a fruiting season to the other. It can therefore be concluded that the maturation period is linked to the genetic factors of each tree because the studies were carried out in the same parkland, thereby minimizing the influence of climatic conditions. Adam and Ferrand (1954) had stated that fruit maturation period was a character related to each tree (early and late variety). Still, these same authors had observed a gradual shift of the period of maturation from the South to the North according to the climatic conditions.

On the basis of foliar parameters, the distinction using immature leaves was clear enough. On the other hand, the classification using mature leave colour was difficult. Among foliar describers, immature leaves and the shape of the mature leaves appeared discriminative and could be used on a larger scale. Otherwise, the field observations showed that some of the phenotypes observed on the immature leaves was correlated with those of the mature leaves. For example, the young leaves presenting the light green phenotype maintained this phenotype in the mature state. A previous study had distinguished several categories of mature leaves within West Africa Sub paradoxa populations (Ruyssen, 1957).
A total of 9 varieties (5 morphological and 4 physiological) have been identified. The distinction of morphological varieties was essentially made on the basis of the shapes and the sizes of fruits and leaves. Otherwise, the multivarious analyses permitted to structure the trees sample analyzed in five phenotypic classes. One of the detail of this work resides in the concordance between the number of morphological varieties described and the number of classes defined by the Hierarchized Ascending Classification (HAC). In next time, interrelationships must be established between central individuals characteristics of every class distinguished using (HAC) and every morphological variety described on a large scale in various environments.

Nevertheless, the distinction of physiological varieties was based on the maturation period of the fruits and their fallen rate. These results agree with those of (Diarrassouba et al., 2007a) carried on quantitative traits which showed that describers bound to fruits and leaves were very discriminative. In a previous study, several varieties have been described (Chevalier, 1948). He distinguished geographical, morphological and physiological varieties. Thereafter he described 8 varieties (var. mangifolium, var. poissoni, var. nilotica, var. cuneata, var. ferruginea, var. flocosa, var. parvifolia and var. serotina) that he reduced to 3 (var. mangifolium, var. poissoni and var. niloticum). He also described two sub varieties within mangifolium on the basis of foliar characters. So the Variety 4 described in our survey presents the same foliar characteristics with sub variety rubifolia (Chevalier, 1943) that presented large leaves that were reddish at the young state. Varieties 3 and 6 could be identified as a sub viridis (Chevalier, 1943) variety that contained small wavy leaves which were light green at the young state. Variety 1 presented the same characteristics with the variety poissoni which grow in Benin and Ghana.

The qualitative characters seemed to have been less influenced by environmental conditions because the observations made on two consecutive years showed that these characters varied little from one year to the next and did not change on the same tree. The survey carried out on the variability of morphological characters showed that Vitellaria paradoxa is characterized by large variability. This natural diversity could do possible for improvement tests on the species.

It would also be possible to extend this survey to other parklands distributed in different climatic zones and to other countries. A survey on the structure of genetic diversity using molecular and biochemical describers seems an interesting perspective for this research as this will permit us to get complementary and useful information.

CONCLUSION

This investigation has brought out some morphological descriptors of shea trees. Some phenotypes were distinguished based on the observations made on the trees, fruits and leaves. Qualitative characters like the shape of the fruit, the colours of the immature fruit and leaves are discriminative. Five morphological varieties were distinguished on the basis of the shapes and sizes of the fruits and leaves. Four physiological varieties were distinguished from the maturation period of the fruits. However, some insensitive variations were recorded from one variety to another for some characters as the shape of the tree.

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Le karité (Vitellaria paradoxa C.F. Gaertn) est un arbre multidimensionnel utilisé quotidiennement par les communautés africaines. L’objectif assigné à cette étude a été d’évaluer le niveau de la variation morphologique puis de proposer une classification variétale à partir des descripteurs discriminants. Quatorze caractères morphologiques ont été analysés sur 124-300 arbres sélectionnés à la station expérimentale de karité de Tengrela. Le résultat a montré l’existence d’une variabilité de la plupart de ces caractères au sein de la population de karité étudiée. Quatre formes du houppier (boule, balai, parasol et dressé), 5 formes chez le fruit (arrondie, ovoïde, poire renversée, fusiforme, et ellipsoïde), 4 phénotypes chez la couleur de la noix (brun clair, brun foncé, brun grisâtre et brun noirâtre), 3 phénotypes chez les jeunes fruits et chez les jeunes des feuilles (vert clair, violacé et rougeâtre) et 3 orientation des rameaux ont été observés. Un total de 9 variétés a été décrit dont 5 à partir des caractères morphologiques et 4 à partir des caractères physiologiques. La distinction de variétés morphologiques a été faite essentiellement sur la base de la forme et de la dimension de fruits et feuilles. Cependant, la distinction de variétés physiologiques a été faite en fonction de la période de la maturation des fruits.

**MOTS CLES** : Côte d’Ivoire - karité - caractères morphologiques - variétés – variation

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<th>Table 1 : Different phenotypes observed on the trees and the leaves and the size of the sample analyzed at every character</th>
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Table 2: Different phenotypes observed on the fruits and the size of the sample analyzed at every character

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Figure 1: Map showing different agro ecological zones and study site in Côte d'Ivoire
Figure 2: Design of the shea park study.
Figure 3: Regrouping shea trees sample using morphological traits

(Dendrogram descended of HCA)
Figure 4A: Ball or spherical shape  
Figure 4B. Broom shape

Figure 4C. Sunshade shape or broadly pyramidal  
Figure 4D. Shape oblong

Figure 4: Scheme showing phenotypic variability of mature shea trees crown
Figure 5: Variability of shea seed colour (light brown, dark brown, greyish brown and black brown)

Figure 6: Phenotypic variability based one immature fruits colour (light green, purple and red)
Figure 7A: Ovoid shape

Figure 7B: Round shape

Figure 7C: Pear reverse shape

Figure 7D: Fusiform shape

Figure 7E: Ellipsoid shape

Figure 7: Phenotypic variability based on shea fruit shape
Figure 8: Compound fruits

Figure 9: Phenotypic variability based on young leaves

Figure 10: Curve of shea fruits fall evolution (example of an early producing tree)
Figure 11: Curve of shea fruits fall evolution (example of intermediate producing tree)

Figure 12: Curve of shea fruits fall evolution (example of a tree with production period spread over early, intermediate and late fruiting seasons.)
Figure 13: Curve of shea fruits fall evolution (example of a late producing tree)

ANNEX 1: SHEA MORPHOLOGICAL DATA COLLECTING SHEET

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**Legend:**
- CSHIP: Canopy shape
- FRUSHIP: Fruit shape
- YLC: Young leaves color
- SECO: Seeds color
- LSHIP: Leaves shape
- BRPEN: Branch pattern
- MALCO: Mature leaves color
- NSD: Number of seed per fruit
- NEF: Number of aborted fruit
- FRPUB: Fruit pubescence
- PULTAS: Pulp taste
- MLCO: Mature leaves color
- LAPIEX: Leaves spp.