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Ethnobotany and Preliminary Characterization of Traditional Cotton (*Gossypium spp.*) in Benin

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Abstract

The present work has been conducted in order to valorize the traditional cotton genetic diversity through an ethnobotany survey. Within this framework, prospections and collections were carried out in three producing agro-ecological zones of cotton in Benin through 38 townships. The results of the investigation put in evidence 135 traditional cotton made up of four types of cotton (61% box, 26% feral, 10% volunteer and 3% wild) and belonging to five species: *Gossypium hirsutum*, *Gossypium arboreum*, *Gossypium trilobum*, *Gossypium herbaceum* and *Gossypium barbadense*. *G. hirsutum* regroups the most traditional cotton (28.1%). All age groups are holders of the accessions of traditional cotton with a prevalence of the producers aged of 40 to 50 years. The organs of the traditional cotton are used without rituals and with rituals to cure natural and para-natural diseases. The diffusion of the seeds (100%) is made between themselves in endogenous way and no lucrative. The survey seems to confirm the localization of Benin in a geographical area with strong morphological diversity of cotton. These cottons constitute significant gene bank for gene recombination in breeding program.

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Keywords

Gossypium spp.;
traditional Cotton;
diversity; agro-ecological zones;
Benin.

Introduction

In Benin, cotton cultivation occupies a prominent place in the economy and in the social life of households. However, despite its importance, the development of cotton growing is confronted with enormous biotic and abiotic constraints. Van Esbroeck and Bowman (1998) pointed out that genetic diversity provides protection against disease and parasites and thus provides a basis for genetic gains for the future. Some traditional varieties, which constitute an important reserve of variability in the world to select new varieties (Cauderon, 1986) are lost (FAO, 1996) because they are threatened not only by climate change but also by other Such as urbanization. Similarly, many authors have drawn attention to the massive losses of traditional varieties (Bellon and Brush, 1994), but cannot be quantified because diachronic studies are rare. For several years, voices have been raised to highlight the risks posed by the inexorable reduction of agricultural biodiversity

(Harlan, 1965). As evidenced by many studies, traditional varieties of cotton that are less susceptible to pests and drought are disappearing in several regions of the tropical world (Yao *et al*., 2006). In Africa, at the beginning of colonization, some policies of systematic eradication led to a disaffection for traditional cotton in favor of modern varieties and a virtual disappearance, particularly in Côte d'Ivoire, Mali, Burkina Faso (Seignobos *et al*., 1991). This threatens the survival of many traditional cotton producers. To counter this disappearance and avoid a biological disaster, several surveys have been carried out in recent years to collect cotton accessions in Australia (Multani and Lyon, 1995); Senegal (Bèye, 1989, Iqbal *et al*., 1997); In Cameroon (Seignobos *et al.*, 1991) and Burkina Faso (Bourgou *et al.*, 2014). In Western and Central Africa, these accessions of cotton from prospecting and collecting in Senegal, Cameroon and Burkina Faso have not been subjected to extensive agromorphological characterization or molecular characterization, thus constituting a limiting factor for a better valorization and Conservation of traditional cotton.

In Benin, little information is currently available on these cotton plants. The resource they represent is not characterized and holders do not have any decision-making tools for their conservation. This situation seriously hinders the conservation and availability of genetic diversity to breeders (Baudoin, 2001). However, a few traditional cotton plants are found in cereal fields, around dwellings, temples of traditional or modern cults, in the wild in forests, in savanna or herbaceous. They have been preserved for various uses such as pharmacopoeia, customary rituals, etc. (Father, 2004).

This work is part of the valorisation of the genetic diversity of traditional cotton through an ethnobotanical study. It aims specifically to inventory the different accessions of traditional cotton farms outside the fields of production in the different agro-ecological zones of Benin and to proceed with the preliminary classification of the accessions of cotton collected.

Materials and Methods

Areas for prospecting and collecting accessions

The surveys and collections of cotton accessions were carried out in 2010 and 2014 in the region between 6 ° 25'N and 12 ° 25 'N (Figure 1). This zone includes 8 out of 12 departments in Benin. It covers three agro-ecological zones according to Sinsin *et al*., 2010: the Sudan zone or Zone I with tropical ferruginous soils, annual rainfall ranging from 900 mm to 1150 mm, a high rainfall deficit with a two-season unimodal regime, A dry and rainy one, situated between 9 ° 45'-12 ° 25 'N beyond the commune of Gogounou and that of Malanville; The zone of transition Guineo-Sudanian or zone II with tropical ferruginous soils, very marked fluctuations of temperature, a rainfall varying between 1100 and 1200 mm per year with a regime passing from the bimodal to the unimodal which encompasses 7 ° 30'-9 ° 45 'N, extending from the commune of Dassa-Zoumè to the latitude of the commune of Bembèrèkè; And the Guineo-Congolese zone or zone III with weakly ferralitic soils, also known as "bar land", a rainfall varying between 900 mm and 1500 mm per year with a bimodal rainfall regime at four (04) seasons, two dry and two Rainfall; Situated between 6 ° 25'-7 ° 30 'N and extending from the coast to the latitude of the commune of Djidja.

Exploration and Investigation

Snowball sampling (Kandall *et al*., 2008) was applied across agro-climatic zones by considering three distinct types of actors: extension workers in the communal sectors of agricultural development (CSAE); Producers of village groups and holders of traditional cotton or their representatives. Extension agents are the beginning of the chain to reach the traditional cotton holders outside the production fields. They allow contact between the investigators and the various village cluster leaders or with the holders they know. Nevertheless, it is the managers of the village groups who, in the majority of cases, give the identity of certain holders and the geographical location of the said cotton producers. These, in turn, will refer investigators to other holders.

At each site, the method of obtaining the data and collecting the accessions consisted of direct interviews with the holders via a pre-established questionnaire, in order to collect the maximum amount of information. The cotton feet were geo referenced using a 62SG GPS and described with the qualitative characteristics commonly used by Vavilov (1935). The local or vernacular names, the main traditional uses, the organs of the plant used, the mechanism of exchange of seeds, the socio-cultural characteristics of the holder (age, sex, level of education, social situation, ethnicity). Of traditional cotton were taken into account. The terminologies used in relation to the environment were voluntary cotton plants (cotton found in the cereal fields, groundnut oil palm oil or cashew tree etc.), cotton trees (cotton trees that grow around the boxes, Houses, dwellings, temples of traditional or modern cults, etc.,

and which are not cultivated for commercial purposes), feral cotton (cotton trees escaped from cultivation and returned to the wild after several generations), and wild cotton (Cotton found in forests, in savanna or herbaceous and which constitute shrubs belonging to uncultivated diploid species). Finally, the harvested samples were identified on the basis of several criteria, in particular the color of the flowers and presence of macule; (IPGRI), Rome, Italy and UPOV (International Union for the Protection of New Varieties of Plants), illustrated by Harem, (2012), published by the International Plant Institute Institute for Plant Genetic Resources (IPGRI). The photos of the different parts of the plant taken were then identified by a team of botanists from the International Center for Research on Cotton in India (ICRC).

Data analysis

The geographical coordinates of the sites on which at least one traditional cotton was found were introduced and analyzed by the Geographic Information System (GIS) of the National Geographic Institute (IGN) using ArcMap software version 9.3. The establishment of the traditional cotton distribution map in Benin (Figure 1). Concerning prospecting, after analysis, the data were analyzed by descriptive statistical methods (frequency, percentage of responses, average). In addition, the traditional cotton holders interviewed were classified by socio-ethnic group according to the classification of the National Institute of Statistics and Economic Analysis of Benin. Then, by categories of sex and age (man, woman, young, adult, old) from the structure proposed by Assogbadjo *et al*., (2008). This structure assumes that young people are between the ages of 30 and 40, adults are between the ages of 40 and 50, and the elderly are people who are older than 50. To analyze the links between the cotton case species and the socio-ethnic groups of the local populations, the independence test χ^2 was carried out. The matrices of the relative frequencies of use of each cotton body organ by the surveyed holders were formed by socio-ethnic groups and by sex and age category. These matrices were subjected to Factor Component Analysis (AFC). These analyzes were carried out with the sphinx software.

Results and Discussion

Socio cultural characteristics of traditional cotton holders

The results reveal that the traditional cotton holders surveyed consisted of 98.7% of men versus 1.3% of women. Moreover, the dependence between educational levels is very highly significant (chi2 = 188.87, ddl = 3, 1-p => 99.99%). The majority of traditional cotton holders are illiterate (92.3%); some have a high school education (5.1%) and some have a level of primary education (2.6%) (Figure 2). The average age of holders of cotton is 45 years. Taking into account the age groups, the distribution of the individuals surveyed is very highly significant (chi2 = 55.46, ddl = 2, 1-p => 99.99%). The majority of people between the ages of 40 and 50 (73.1%), they are followed by individuals over the age of 50 (14.1%) and those under 40 (12.8%) (Figure3).

With regard to the distribution of holders in the socio-professional groups, farmers make up 50.0% of the holders and constitute the majority group (Figure 4). The succession in descending order of the other groups is as follows: Tradi-practitioner (25.6%), Craftsman (16.7%), Trader (3.8%) and Official (1.3%). The dependence with the reference distribution is very highly significant (chi2 = 110.82, dd1 = 6, 1-p => 99.99%).

Taking ethnicity into account, the dependence is very highly significant (chi2 = 50.00, ddl = 11, 1-p => 99.99%). Bariba are the majority, accounting for 24.4% of the cotton holders. They are followed by Adja (15.4%), Ifè (12.8%), Idasha (11.5%), Yoruba and Fon (9.0%) and Mahi (6.4%) (Figure 5).

Inventory of traditional cotton according to agro-ecological zones

The results of the survey showed 135 traditional cotton plants across 98 villages in Benin's agro-climatic zones. Of these 135 traditional cotton, 52.6% come from the Guineo-Sudanianzone, 25.9% from the Guineo-Congolese zone and 21.5% from the Sudanian zone. Of the three agro-ecological zones, most of the traditional cotton (Figures 6 and 7) were counted mainly on the edge of the huts (cotton plant 57.8%). The others are distributed along the roads (feral cotton 28.1%), fields (wilful cotton 11.9%) and fallow (wild cotton 2.2%).

The Guineo-Sudanian zone accounted for 28.9% of cotton, followed by the Guineo-Congolese zone (19.3%) and the Sudanian zone (9.6%), making these zones the most important zones of cotton growing. Concerning cotton farmers, they were respectively 15%, 11% and 2% in the Guineo-Sudanian, Sudanese and Guineo-Congolese zones. In the Guineo-Sudanian zones, 4% in the Guineo-Congolese zone and very weak (1%) in the Sudanian zone are also few (7%) wilful cotton workers.

Finally, wild cotton was encountered only in the Guineo-Congolese zone (2%) (Figure8). The dependence of the distribution of the types of cotton according to the different agro-ecological zones is very highly significant (chi2 = 18.38, ddl = 6, 1-p = 99.47%).

Preliminary Classification of Collected Cotton Accessions

The *in situ* description made it possible to highlight the heterogeneity that exists within the accessions held by the local populations. In terms of their botanically specific richness, 60% of the cotton is attributed to the species *G. Hirsutum* (creamless petal flower without macule and cream pollen and green leaves, webbed); 28.1% to species G. Arboreum (red petal flower, strongly spotted and with dark yellow pollen Green leaf, digitated); 5.9% to species *G. Trilobum* (yellow petal flower, strongly spotted and with dark yellow pollen, light green leaf, palmate to digita); 4.4% to the species *G. Herbaceum* (yellow petal flower, medium stain and cream pollen, green leaves, palmated to digita) and 1.5% to species *G. Barbadense* (petal flower cream Weakly spotted and with cream pollen, light green leaf, palmate) (Figure 8). The distribution of cotton accessions from one species to another is very highly significant (chi2 = 165.33, ddl = 4, 1-p => 99.99%).

The distribution of the different species by agro-ecological zone shows a very highly significant dependence (chi2 = 33.68, ddl = 8, 1-p => 99.99%). *G. hirsutum* and *G. arboreum* predominate in the Guineo-Sudanian zone. Cotton plants of the species *G. trilobum* are the most dominant in the Guineo-Congolese zone. On the other hand, the species *G. barbadense* is present only in the Guineo-Congolese zone. *G. herbaceum* cotton is also found in the areas of Sudan and Guinea-Sudan, where they predominate.

In addition, all cotton species are used as cotton plants with a predominance of *G. hirsutum* (27.4%) and *G. arborum* (23.7%). It is remarked that no wild cotton is of the species *G. barbadense*nor of the species *G. arboreum*. The majority of feral and willful cotton plants are of the species *G. Hirsutum* (23.7% and 8.1%). The dependence is very significant (chi2 = 34.15, ddl = 12, 1-p = 99.94%).

Local designation of hut cotton

Ethnobotanical investigation in the various localities where cotton-growing cotton has been identified has shown that each cotton accession is designated in the holders by a generic or specific name (Figure 9). The local name (Avokangbogbli-kètchè) is the same for the Adja, Fon, and Mahi, while the Bariba give four vernacular names (Win-Korou, Hounssou- Deka, Couhountou and Winsoutikpi). The ethnic groups Yorouba, Dendi, Peuhl and Boo each have their own vernacular names, respectively, Owu, Haabou-Touri, Boumli and Habou. The dependence is very significant (chi2 = 607.87, dd1 = 150, 1-p => 99.99%).

Uses of traditional cotton

This study showed that the organs (leaves, stem, root, flower, seed and fiber) are used either alone or together. The leaves are the organ most used by traditional cotton holders (Figure 10). The difference observed in the use of different cotton organs is very significant (chi2 = 294.42, ddl = 6, 1-p = 99.99%). The ethnic groups Adja, Fon, Biali, Yom, Dendi and Peuhl use only the leaves of the cotton box to cure certain diseases (natural or para-natural), to perform certain ritual ceremonies and to feed the animals. The seeds and fibers are used by the Bariba respectively for medicinal and ceremonial purposes and to manufacture lantern wicks. As for the stem, it is used by the Bariba and Boo to cure certain diseases, to perform certain ritual ceremonies and as firewood (Figure 11). The dependence is not significant (chi2 = 30.39, ddl = 55, 1-p = 0.29%)

Exchange mechanisms for traditional cotton seed

In a strategic way, the farmers keep the cotton accessions by taking the seeds in the harvest. Transfers of traditional cotton seed are done informally between parents, friends, farmers and tradi-practitioners, without any constraint and never on a commercial basis. All holders of traditional cotton boxes declare that they have received the said seeds free of charge.

This study was initiated to highlight the genetic diversity of traditional cotton by means of prospections and collections in Benin in order to find traditional cotton products, as has been done in other countries by several authors such as Iqbal *et al*., (2001), Abdalla *et al*., (2001), Lu and Myers 2002 in the United States; Multani and Lyon 1995 in Australia; Iqbal *et al*., (1997); Bèye (1989) in Senegal; Seignobos *et al*., (1991) in Cameroon and Bourgou *et al*., (2014) in Burkina Faso. Thus, it was possible to identify 135 traditional cotton plants belonging to five cotton species throughout the whole of Benin, whereas those recorded by Seignobos *et al*.,

(1991) in Cameroon come from four species. These are G. hirsutum, G. arboreum, G. herbaceum, G. barbadense. In the case of Benin, in addition to the same four species encountered, we must add the species G. trilobum. The species G. hirsutum is the most widespread in all three agro-ecological zones of Benin, namely Sudanian, Guineo-Sudanian and Guineo-Congolese. Box cotton appears in large numbers in the three agro-ecological zones with a high percentage (29%) in the Guineo-Sudanian zone. Box cotton varieties exhibited broader variability than other types of cotton. This large variability of the cotton boxes could be explained by the fact that, apart from the shape of the leaves, the color of the flowers, cotton boxes are used for therapeutic and ritual purposes. These accessions would thus be preferred by practitioners and are the subject of important non-financial exchanges of seeds. The wild cotton is very weakly represented, and this only in the Guineo-Congolese zone. This is probably due to the agro-ecological conditions and the cultural practices favorable to their development (progressive melting of the two rainfall peaks, average rainfall 1100 to 1200 mm, average temperature 32 ° C with tropical ferruginous soil). Seignobos and Schwendiman, (1991) reported that on the eve of colonization, Africans were forced to abandon their traditional varieties to adopt introduced varieties; which would justify the low proportion of traditional cotton.

Seeds are naturally indispensable for the survival of cotton species, so that the surveys carried out an important part concerning their management and conservation. Answers to these questions show that the distribution of traditional seeds is simply done between relatives and friends. The conservation of these seeds among the holders is carried out to the detriment of the required standards. This study should be a starting point for a well-organized collection of the seeds of these traditional cotton species to make them properly preserved in strict accordance with the standards required for their proper preservation.

The surveys also noted that, apart from the industrial and commercial side of cotton, cotton plants have not only therapeutic but also ritual virtues. Indeed, the various organs of these cotton plants each serve to cure an evil. In the case of Benin, leaves are the organ most used by traditional cotton holders. For example, the ethnic groups Adja, Fon, Biali, Yom, Dendi and Peuhl use only cotton leaves to cure certain natural or para-natural diseases. It is important to emphasize that it is mainly cotton that is used in medicinal and ritual uses. This would explain their presence around the boxes. This Position gives them the name of box cotton contrary to the three other types of cotton that are far from the huts whose therapeutic uses are very little known.

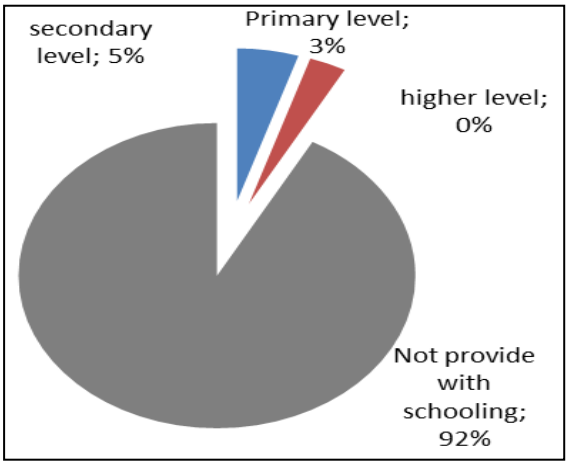


Figure.1 Educational levels of the holders of traditional cotton plant

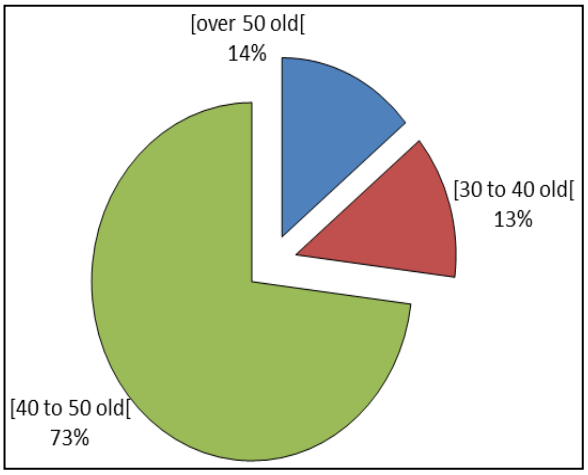


Figure.2 Distribution of the traditional holders of cotton plant according to the age

Fig.3 Rate of the various surveyed socio-professional groups

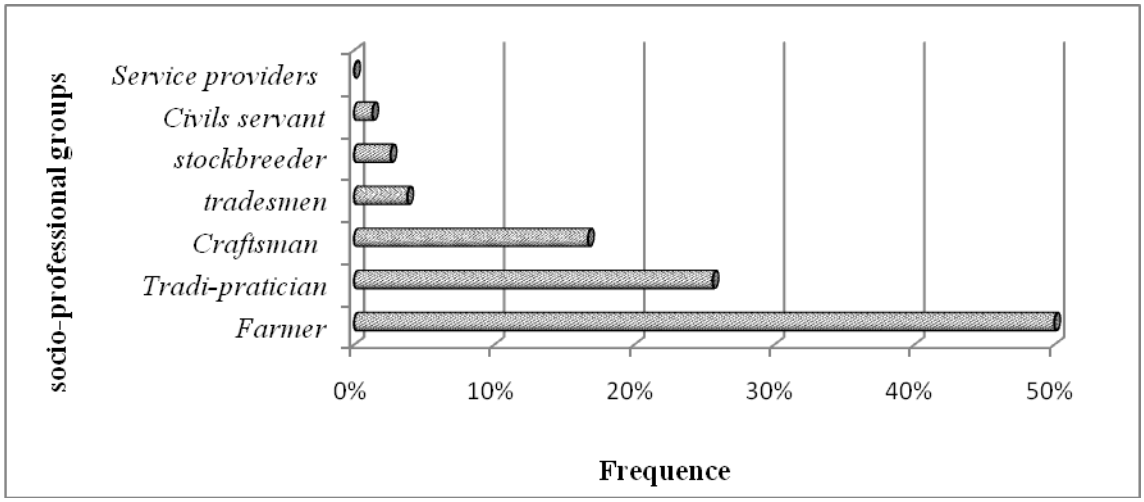


Fig.4 Various surveyed sociocultural groups

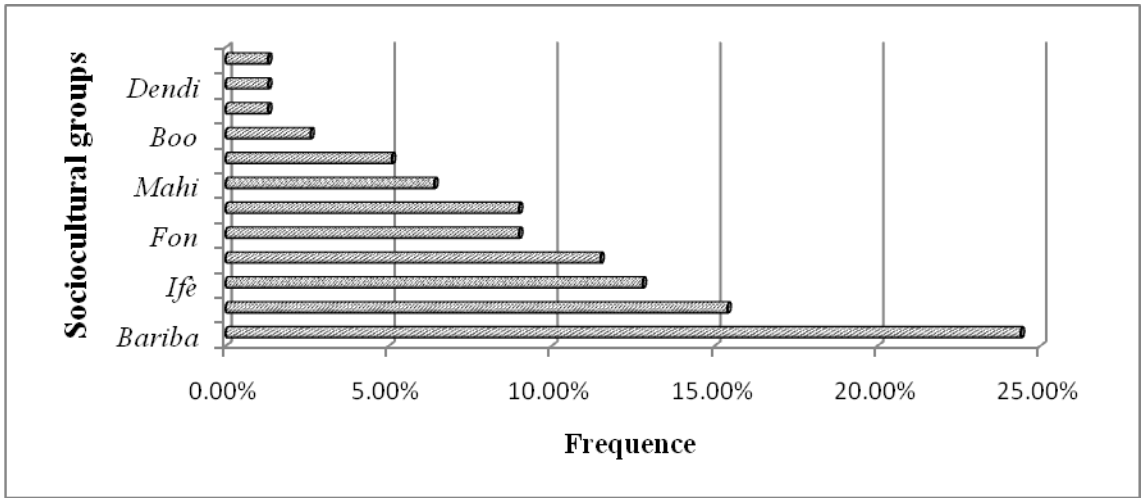


Fig.5 Various types of collected traditional cotton plants

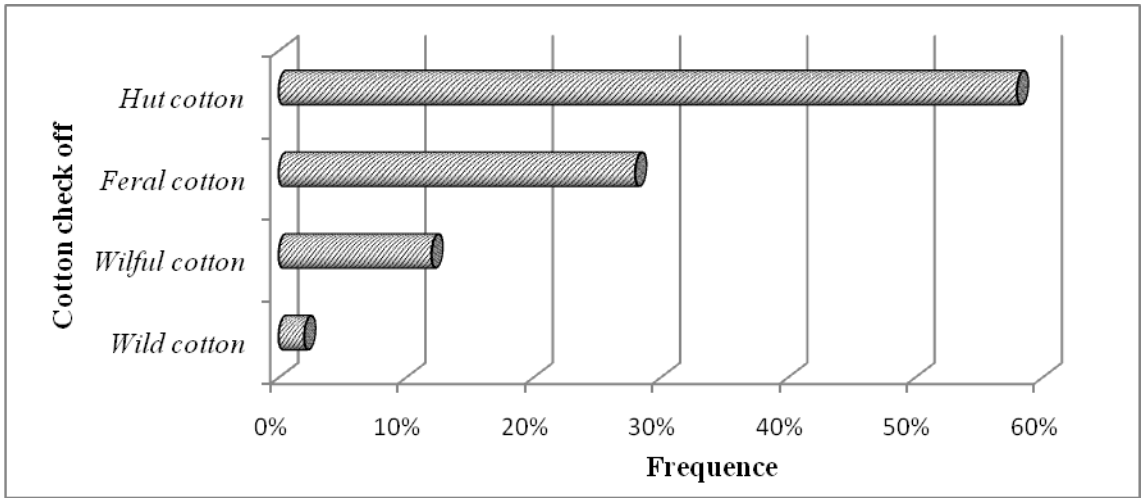


Fig.6 Photographs of the inventoried and listed traditional cotton

Fig.7 Distribution of the types of cotton according to the various agro-ecological zones

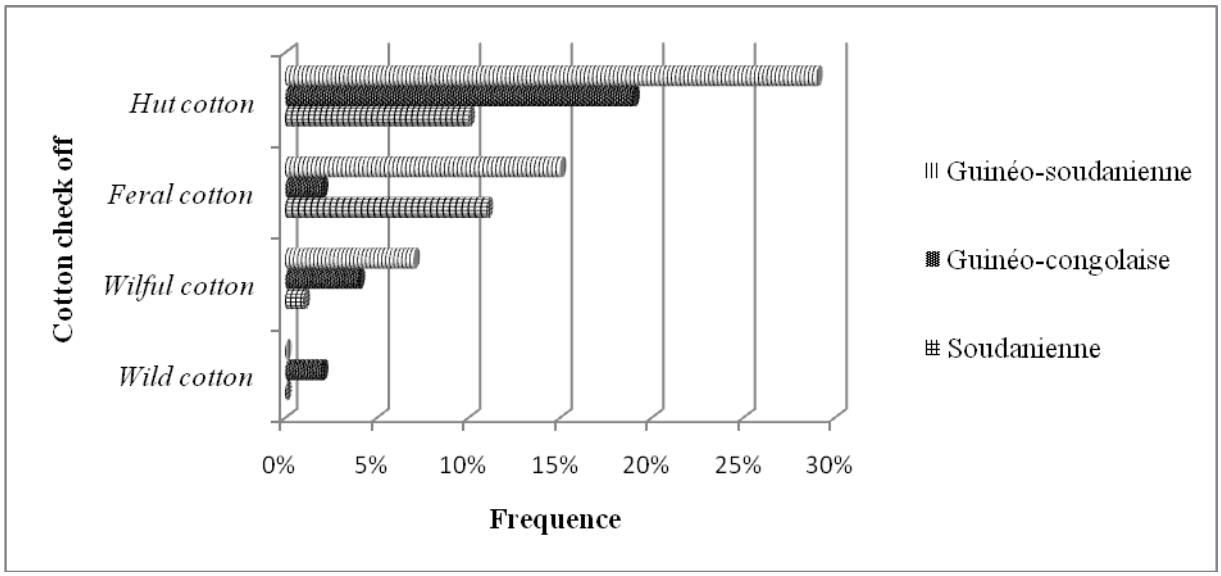


Fig.8 Preliminary classification of the traditional cotton plants

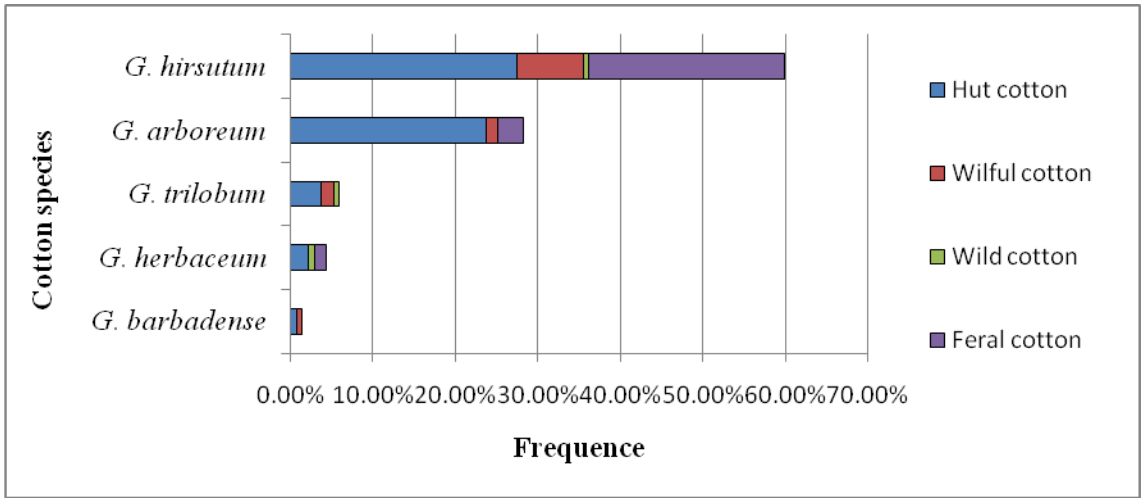


Fig.9 Designations of the traditional cotton plants according to the sociocultural groups

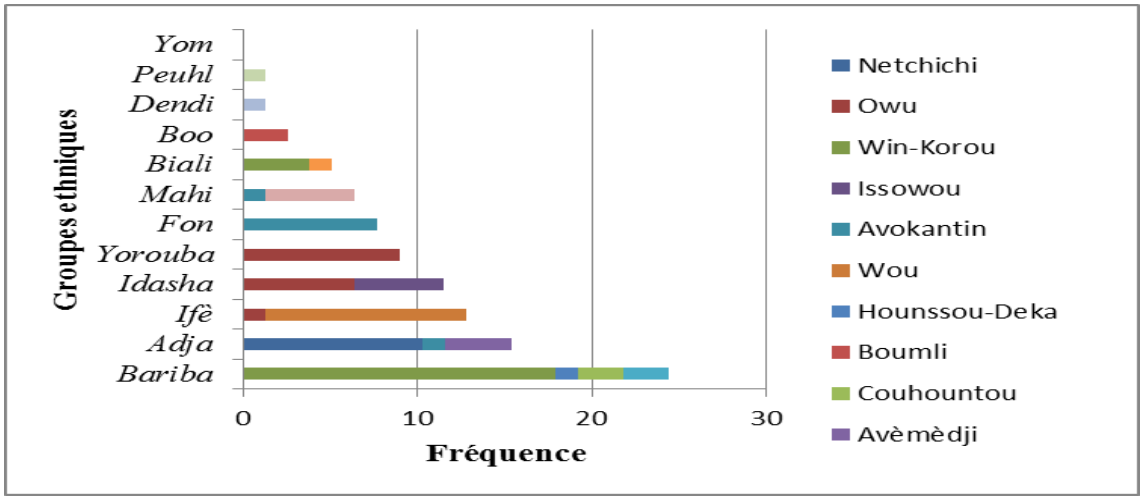


Fig.10 Cotton organs used by the local populations

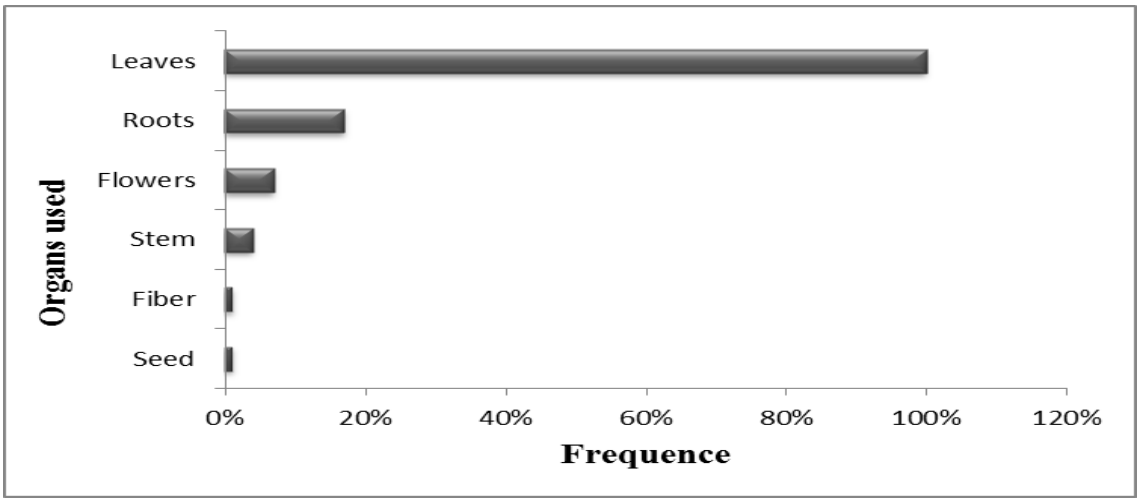
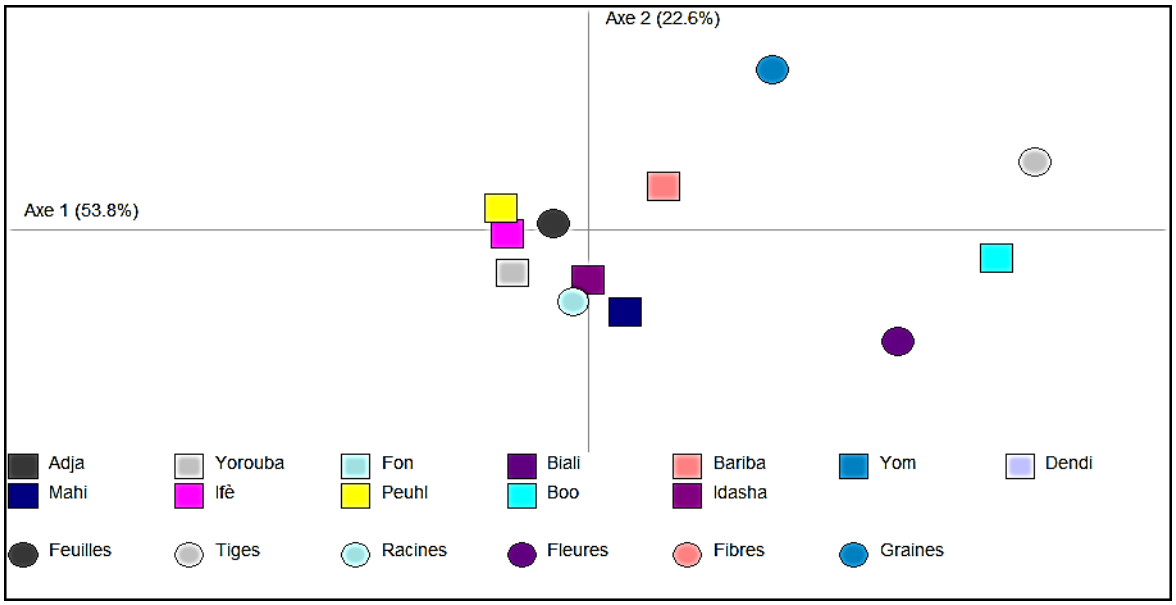


Fig.11 Analyze factorial correspondences (AFC) matrix "groups ethniques X various cottonorgans used"



Moreover, all age groups are the owners of traditional cotton accessions with a predominance of producers aged 40 to 50 years, contrary to the results of Houédjissin *et al*., (2016) on Pentadesma butyracea revealing the ignorance of this species by the class of the young. This reassures that knowledge transfer on traditional cotton is not hypothecated. The in situ description made it possible to highlight the heterogeneity that exists within the accessions held by the farmers and those found in the nature belonging to the three other types of cotton namely: wild, feral and voluntary. It is noteworthy that these four types of cotton belong to the five listed species of which the species Gossypium trilobum which is not cultivated. This heterogeneity on the botanical level constitutes a reservoir of genes to be drawn by the selection to improve the varieties in extension in Benin at a time when the climatic changes have perverse effects on the cultures.

Considering the local designation of cotton boxes, it appears that in almost all localities, the names given are revealing and are different from one locality to another. These names may take into account the names used to designate conventional cotton in the locality. In this case the name is composed or quite different, emphasizing a characteristic aspect of this type of cotton. This then indicates the originality of this type of cotton tree giving it its mystical or ritual power.

Conclusion

This study revealed a rich diversity among traditional cotton farmers in Benin. Similarly, beyond the usual economic interest of cotton growing is the knowledge and endogenous uses of cotton plants. The in situ description made it possible to highlight the heterogeneity that exists within the accessions held by the local populations and those found in the nature belonging to wild, feral and voluntary cotton plants. It is noteworthy that these four types of cotton belong to the five listed species of which the species Gossypium trilobum which is not cultivated. This high diversity is maintained and managed by local populations in the Guinea-Sudanian zone. It is a reservoir of genes to be used by breeders to improve extension varieties in Benin at a time when climate change is having a perverse effect on crops. However, it is necessary to develop strategies for the conservation and valorisation of this traditional cotton. Similarly, research efforts for a molecular agro-morphological and molecular characterization of cotton accessions are necessary to facilitate conservative, efficient and sustainable management of these plant genetic resources in cotton improvement.

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