ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 9, Issue, 02, pp.47089-47096, February, 2017

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

AGROMORPHOLOGICAL CHARACTERIZATION OF ACCESSIONS OF TRADITIONAL COTTON (GOSSYPIUM SPP) COLLECTED IN THE AGROECOLOGICAL ZONES PRODUCING COTTON IN BENIN

[1] Sinha, M.G., [1]Djaboutou, M. C., [2,*]Houedjissin, S.S., [3]Quenum, F.J.B. [2]Cacaï, G.H. and [2]Ahanhanzo, C.

[1]Institut National des Recherches Agricoles du Bénin, Centre de Recherches Agricoles Coton et Fibres.
[2]Département de Génétique et des Biotechnologies de la Faculté des Sciences et Techniques de l'Université d'Abomey-Calavi, Benin
[3]Département de Production Végétale, Faculté des Sciences Agronomiques, UAC

ARTICLE INFO

Article History:
Received 17th November, 2016
Received in revised form
20th December, 2016
Accepted 15th January, 2017
Published online 28th February, 2017

Key words:
Gossypium Spp,
Accessions,
Biodiversity,
Benin,
Agromorphological Variability.

ABSTRACT

Sixty-six traditional cotton accessions (*Gossypium* spp), collected in Benin, and were characterized by a set of 31 agromorphological traits established by UPOV and IPGRI. The evaluation was carried out during the 2011-2012 rainy season through a randomized complete block design at Cana CPE. Statistical analysis showed very highly significant differences between accessions for the 15 qualitative characteristics observed. The accessions Q111, Q122, Q95, Q93, Q135, Q92, Q71 and Q90 have characteristics of higher qualities. Analysis of the Pearson correlation matrix showed strong positive and negative correlations. The first two axes of the PCA absorb 73% of the total variability of the quantitative characters (54% for the vegetative development and 19% for the precocity). The first two factors of the CFL of qualitative traits account for 82% of inertia (70% for petal color, macula, pollen color and leaf shape, 12% for hairiness in lower part of The leaf, the denticulation of the bracts, the size of the capsules and the shape of the plant). The ascending hierarchical classification based on the Euclidean distance divided the accessions into six distinct groups comprising respectively 2, 14, 8, 11, 2 and 29 accessions. The results of this study provide information that can be used for the conservation and rational use of biodiversity for the improvement of commercial varieties.

Citation: Sinha, M.G., Djaboutou, M. C., Houedjissin, S.S., Quenum, F.J.B. Cacaï, G.H. and Ahanhanzo, C., 2017. "Agromorphological characterization of accessions of traditional cotton (Gossypium spp) collected in the agroecological zones producing cotton in Benin", *International Journal of Current Research*, 9, (02), 47089-47096.

INTRODUCTION

In Benin and most cotton-producing countries in West Africa, cotton is the main cash crop and plays an important social and economic role. The cotton *Gossypium.* Spp was cultivated in 2015 on an area of 33.9 million hectares (ha) with a production of 21.02 million tons of fiber, of which 8.6% of the area and 5.4% of the production of Fibers in French-speaking Africa (CICC, 2016). But there is a stagnation of seed cotton production around 300 000 tonnes in Benin over the last four cotton seasons with a low average yield of seed cotton. Genetic traits that make it possible to produce more for a lower cost are, first of all, those that remove the abiotic and biotic constraints that limit production (Mendez del Villar *et al.,* 2006).

***Corresponding author: Houedjissin, S.S.,**
Département de Génétique et des Biotechnologies de la Faculté des Sciences et Techniques de l'Université d'Abomey-Calavi, Benin.

Similarly, it is necessary to improve the agronomic, morphological and technological characteristics of the existing varieties which can meet the requirements of the actors of the cotton sector, based on the old varieties of cultivated plants, often referred to as "traditional", "Local" or "country" (Marchenay *et al.,* 1987). Traditional varieties are also the basic material for today's biologists and breeders: they find the genes they will need tomorrow to better understand the nature of diversity and to use it more effectively (Marchenay *et al.,* 1987). Traditional varieties must be maintained: so that genetics and breeding can continue to create new varieties that will allow agriculture to adapt to an uncertain future (Marchenay *et al.,* 1987). Traditional varieties have long been modeled in each region by farmers in order to adapt them to their needs, as well as to selection pressures related to cultivation techniques (Sié, 1998, Harlan, 1987). These varieties thus constitute an important reserve of variability for breeders, which justify their systematic collection (Cauderon, 1986) and their evaluation (Sié, 1998).

The anthropogenic pressure exerted on the different parts of the traditional cotton tree, especially the roots and the new cultivation techniques practiced by the producers, can lead in time to the loss of the variability existing in these accessions. Indeed, if the genetic variability is the raw material of the breeder, it can be kept efficiently only after a precise knowledge of it. Not only does this knowledge allow good preservation; but also the diversity available for improvement and the genetic structure of the forms preserved in situ. There are studies of genetic variability in India, China, the United States and Brazil, where traditional cotton is widely used, but under very different agro-climatic and socio-economic conditions. In West and Central Africa, some studies have characterized and valued the genetic potential of local cotton farmers (Lhuillier, 1950, Franquin, 1954, Fournier and Gurknecht, 1991, Seignobos and Schwendiman, 1991). In Benin, on the other hand, there is no collection of traditional cotton genotypes that would allow conservation and rational use. In the absence of such a collection, it is difficult to design a cotton plant breeding program that can meet the needs of a country subjected to harsh abiotic and biotic conditions. In Benin, no studies on the characterization of traditional cotton have been carried out. This is why any contribution to the maintenance and valorization of genetic resources (Franckel *et al.,* 1995) must precede a study of its genetic diversity. This is the starting point of any program to improve and produce new varieties of cotton. Therefore, the objectives of the present investigation are to assess the structure and agromoprogological variability of traditional cotton accessions collected in Benin by using morphological markers.

MATERIALS AND METHODS

Vegetable material

Traditional cotton samples from collections in the Guineo-Congolese, Guineo-Sudanese and Sudanian zones (Sinha *et al.,* 2016) have been used. Accessions of traditional non-germinated cotton or without sufficient seeds have been eliminated. Sixty-six (66) accessions collected in farmers' fields, in houses, in forests and along roadsides were characterized.

Description of the experimental site and technical itinerary

Agromorphological characterization was carried out at the Permanent Center for Experimentation (CPE) in Cana (7 ° 6'11 " East, 2 ° 5'17 " North, and 89 m altitude) during the 2011 - 2012 rainy season. The CPE is characterized by a ferralitic soil, denatured, developed on clay-sandy sediments of the continental terminal (bar land) and a climate of Guinean type with a bimodal regime with two rainy seasons intercalated by two dry seasons (mean annual rainfall was 1,300 mm in 2012 against 1,043 mm in 2011). Cotton accessions were characterized in a randomized complete block design without replication. Plots were single rows, 5m in length and 1m apart with 0.5m plant spacing. Each accession was sown 10 plants per plot. . The seeds were soaked in water 24 hours before sowing. Soil preparation was manual (0.20 to 0.25 m depth). The accessions were numbered from Q61 to Q140. Technical routes have been monitored according to research recommendations, but other cropping factors are optimized, particularly mineral fertilization, weed control and insect pest control. The mineral fertilizer was based on 250 kg of N14P23K14S5B1 brought on the 15th day after sowing (das) followed by a 50 kg / ha supply of urea and an additional 50 kg of KCl at the 40th das. Six weedings and a hoeing in the 50th das enabled the effective control of the weeds. Insecticide protection reinforced by systematic weekly sprays starting from the 50th das to the harvest in order to effectively control the parasitic pressure of the insects; The first four insecticide sprays were based on Thian; The following sprays combined a pyrethroid product with an acaricid or aphicid organophosphorus product depending on whether it was at mid-bloom or at the end of bloom. The marking of 4 plants per accession was carried out at random in the 90th das, with woolen strings and numbered from 1 to 4 on each row.

Quantitative agromorphological variables observed

Fifteen (15) quantitative agromorphological characters selected from the list of cotton descriptors (UPOV, 2001) and illustrated by Harem *et al.* (2012) made it possible to characterize the various accessions. The following quantitative agromorphological variables were measured: mean date of first flower appearance (MDFFA), average opening date of the first boll (AODFB), ginning outturn (GO), weight of 100 seeds (g) or Seed Index (SI), height of the main stem (HT), insertion height of the first fruiting branch (IHFFB), length of the longest vegetative branch (LVB), length of the longest fruiting branch (LFB),number of nodes on the main stem (NN), number of insertion nodes of the first fruiting branch (NNFB), number of fruiting branches (NFB), number of nodes on vegetative branches (NVB), percentage of bolls on fruiting branches (% BFB) and percentage of bolls on vegetative branches (% BVF).

Statistical analysis of data

The data obtained was processed using the Microsoft Excel 2010 spreadsheet and analyzed for variance analysis. Minimums, maxima, averages, standard deviations and coefficients of variation were then determined. The assessment of the structuring of agromorphological diversity was carried out by a Principal Component Analysis (PCA), an Ascending Hierarchical Classification (HAC) and a Discriminant Factorial Analysis (AFD) using the software STATISTICA version 6.1. Heritability (h^2) of morphological characters was also estimated in order to assess the proportion of the phenotypic variability of genetic origin which is heritable and fixable in whole or in part.

RESULTS AND DISCUSSION

Variability of quantitative characteristics

The analytical characteristics of the variance such as minima, maxima, averages, standard deviations, coefficients of variation and Fisher's F-meanings are presented in Table 1. The analysis in the table highlights differences very significant between the various accessions for all the characters ($P < 0.0001$). Significant differences were found between the minimum and maximum values of the 15 quantitative variables. The total height of the plant (HT) ranged from 105 to 305 ± 20.4 cm. The insertion height of the first fruiting branch (IHFFB) ranged from 0 to 98 cm. The length of the vegetative branches (LVB) ranged from 32 to 160 cm. The length of the fruiting branches (LFB) ranged from 0 to 90 cm.

Table 1. Results of the variance analysis realized on the measured variables

Variables	Mean	Min	Max	Stan.Dev	CV%	h^2	F	P<F
HT	198	105	305	20,4	14,6	>0,80	12,7	***
HPBF	24	0	130	4,2	24,1	-	105,8	***
LBV	96	32	160	17,6	25,9	>0,80	4,0	***
LBF	27	0	90	6,2	32,0	-	44,9	***
HNR	5	3	12	1,3	34,5	0.55	2,3	***
NN	40	23	67	4,6	16,4	>0,80	8,6	***
NPBF	7	0	25	1,0	20,2	-	122,6	***
NBF	12	0	38	2,4	28,5	-	52,9	***
NBV	19	1	43	2,5	18,8	>0,80	46,0	***
CBF	36	0	94	8,5	33,0	-	36,4	***
CBV	64	6	100	8,5	18,9	-	36,5	***
RE	25	18	43	2,2	12,0	>0,80	19,4	***
SI	7	5	11	0,6	12,3	>0,80	10,2	***
PFM	112	65	143	3,1	4,0	>0,80	99,9	***
OPCM	157	112	193	2,7	2,4	>0,80	146,7	***

P:*** Very highly significant ($p < 0.001$); CV%: Coefficient of variation expressed as a percentage; Min: minimum; Max: maximum; HT (cm): height of a seedling, LBV (cm): length of vegetative branch, LBF (cm): fruit-bearing length of branch, NN: numbers nodes, HNR (cm): height of internode, HPBF (cm): height of insertion of the first fruit-bearing branch, NPBF: node of insertion of the first fruit-bearing branch, NBF: numbers fruit-bearing branches, NBV: numbers vegetative branches, % CBF: percentage of bolls collected on the fruit-bearing branches, %CBV: percentage of bolls collected on the vegetative branches, RE: Output with shelling, IF: seed index, PFM: goes back to appearance average of the flowers, OPCM: goes back to average opening of the bolls

Table 2. Stamp correlation of Pearson of the qualitative characters of cotton plant

Variables	HT	HPBF	LBV	LBF	HNR	NN	NPBF	NBF	NBV	%CBF	%CBV	RE	SI	PFM	OPCM
HT	1														
HPBF	-0,35	1													
LBV	0,39	-0,06	1												
LBF	-0,49	0,48	-0,03	1											
HNR	0,40	-0,34	0,12	-0,26	1										
NN	0,59	0,12	0,24	-0,14	-0,33	1									
NPBF	-0,43	0,94	-0,08	0,57	-0,38	0,09	1								
NBF	-0,42	0,62	-0,05	0,85	-0,34	0,05	0,70	1							
NBV	0,69	-0,49	0,21	-0,82	0,28	0,34	-0,58	-0,80	1						
%CBF	-0,55	0,61	-0,16	0,81	-0,33	-0,13	0,70	0,85	-0,84	1					
%CBV	0,55	-0,61	0,16	-0,81	0,33	0,13	-0,70	-0,85	0,84	-1,00	1				
RE	-0,44	0,05	-0,16	0,49	-0,05	-0,44	0,06	0,31	-0,54	0,40	-0,40	1			
SI	-0,40	0,06	-0,17	0,46	-0,07	-0,37	0,12	0,37	-0,48	0,46	-0,46	0,38	1		
PFM	0,47	-0,05	-0,03	-0,72	0,06	0,40	-0,15	-0,58	0,73	-0,62	0,62	-0,59	-0,50	1	
OPCM	0,46	0,02	0,00	-0,64	0,03	0,42	-0,09	-0,49	0,65	-0,54	0,54	-0,54	-0,43	0,87	1

Values in fat are significantly different from 0 on a level of significance alpha=0,01 (Pearson correlation), HT (cm): height of a seedling, LBV (cm): length of vegetative branch, LBF (cm): fruit-bearing length of branch, NN: numbers nodes, HNR (cm): height of internode, HPBF (cm): height of insertion of the first fruit-bearing branch, NPBF: node of insertion of the first fruit-bearing branch, NBF: numbers fruit-bearing branches, NBV: numbers vegetative branches, % CBF: percentage of bolls collected on the fruit-bearing branches, %CBV: percentage of bolls collected on the vegetative branches, RE: Output with shelling, IF: seed index, PFM: goes back to appearance average of the flowers, OPCM: goes back to average opening of the bolls

Table 3. Eigen values and contribution of the characters to axes 1 and 2 of the CPA

	PC1	PC2
explicative variance (%)	54	19
HT	-0,27	-0,12
HPBF	0,23	-0,37
LBV	-0,08	-0,06
LBF	0,32	-0,02
HNR	-0,18	0,34
NN	-0,12	-0,45
NPBF	0,24	-0,38
NBF	0,31	-0,18
NBV	-0,34	-0,03
%CBF	0,34	-0,10
%CBV	-0,34	0,10
RE (%)	0,21	0,32
SI (g)	0,22	0,25
PFM (jas)	-0,27	-0,28
OPCM (jas)	-0,24	-0,31

HT (cm): height of a seedling, LBV (cm): length of vegetative branch, LBF (cm): fruit-bearing length of branch, NN: numbers nodes, HNR (cm): height of internode, HPBF (cm): height of insertion of the first fruit-bearing branch, NPBF: node of insertion of the first fruit-bearing branch, NBF: numbers fruit-bearing branches, NBV: numbers vegetative branches, % CBF: percentage of bolls collected on the fruit-bearing branches, %CBV: percentage of bolls collected on the vegetative branches, RE: Output with shelling, IF: seed index, PFM: goes back to appearance average of the flowers, OPCM: goes back to average opening of the bolls

The height of the internodes per plant (HIP) ranged from 3 to 12 cm. The total number of nodes (NN) ranged from 23 to 67. The number of insertion nodes of the first fruiting branch (NINFB) varies from 0 to 25. The number of fruiting branches (NFB) ranged from 0 to 38 fruiting branches. The number of vegetative branches (NVB) ranged from 1 to 43 vegetative branches. The percentage of capsules per plant harvested on the fruiting branches ranged from 0 to 94% and finally the percentage of bolls per plant harvested on the vegetative branches ranged from 6 to 100%. Coefficients of variation (CV%) indicate small variations ranged from 2.4 to 4% between accessions respectively for the average opening date of the first boll (AODFB) and the date of appearance of the first flower average (DAFFA). Conversely, there is a very large variation between the accessions for the height of the internodes on the main stem (HIMS), the percentage of the boll on the fruiting branches (%BFB), the length of the longest fruiting branch (LFB), the number of fruiting branches (NFB) and the length of the vegetative branches (LVB) (35%, 33%, 32%, 29% and 26% respectively).

branches (NBV) have very high heritability (h^2 >0,80) Height to node ratio (HNR) is average (h^2 = 0.55). This would indicate that genotypic variances are superior to those of the environment. The variability observed in these characteristics between accessions is therefore due to a large part of the genotype. According to Copur, (2006), significant variability in morphological characteristics can be attributed to differences in the genetic make-up of accessions. Similarly, Mandal *et al.* (2008) note that a high value of heritability is due to additive effects that ensure that progeny selection would be effective for the trait (s). This makes it possible to say that the selection of cotton accessions studied could be effective from these variables. However, this variability could also be explained by the diverse geographical origin of accessions (Aghaee *et al.,* 2010) and by farmer practices in seed management (Adoukonou-Sagbadja *et al.,* 2007). Similarly, several authors have shown that farmers' practices in seed management, including the exchange of varieties among farmers, are the source of a significant diversity between

Table 4. Characteristics of the 6 groups of the accessions of traditional cotton plants resulting from the CAH

Variables	G I	G II	G III	G IV	G V	G VI	F	P
N		19	11	12	9	8	7	
HT	257,05±3,8^{a}	213,81±5^{b}	200,7±4,7^{b}	144,44±5,5^{c}	131,87±5,87^{c}	153,28±6,27^{c}	103,8	<0,000
HPBF	0±1,63^{d}	48,54±2,15^{b}	0±2,06^{d}	65,55±2,37^{a}	20,5±2,51^{c}	28,28±2,69^{c}	191,5	<0,000
LBV	110,3±3,2^{a}	103,45±4,3^{ab}	84,25±4,1^{c}	86,66±4,79^{bc}	64,12±5,08^{d}	116,85±5,43^{a}	17,51	<0,000
LBF	0±1,54^{c}	57,81±2,03^{a}	0±1,94^{c}	32,55±2,24^{b}	59±2,38^{a}	58,57±2,54^{a}	213	<0,000
HNR	6,26±0,21^{a}	4,36±0,28^{cd}	5,66±0,27^{ab}	3,88±0,31^{d}	4,87±0,33^{bcd}	5,42±0,35^{abc}	11,54	<0,000
NN	44±0,94^{c}	52±1,23^{c}	38,58±1,18^{c}	37,66±1,36^{c}	28±1,44^{c}	30,28±1,54^{c}	45,49	<0,000
NPBF	0±0,31^{d}	15,27±0,41^{b}	0±0,39^{d}	19,33±0,45^{a}	7,25±0,48^{c}	9,28±0,51^{c}	391,6	<0,000
NBF	0±0,51^{d}	28,54±0,67^{a}	0±0,64^{d}	15,44±0,73^{c}	20,87±0,78^{b}	21,85±0,83^{b}	363,1	<0,000
NBV	31,89±0,57^{a}	11,45±0,76^{c}	27,58±0,72^{b}	12,66±0,83^{c}	3,5±0,89^{d}	5,42±0,95^{d}	262	<0,000
CBF	0±1,55^{c}	75,09±2,04^{a}	0±1,96^{c}	55±2,26^{b}	80,37±2,40^{a}	63±2,56^{b}	351,5	<0,000
CBV	100±1,55^{a}	25,27±2,04^{c}	100±1,96^{a}	45,55±2,26^{b}	20±2,40^{c}	37,42±2,56^{b}	350	<0,000
RE	21,78±0,64^{c}	24,27±0,84^{c}	23,5±0,80^{c}	24,77±0,93^{c}	36,5±0,99^{a}	29,71±1,06^{b}	36,48	<0,000
SI	6,21±0,14^{b}	6,90±0,18^{b}	6,25±0,18^{b}	6,66±0,21^{b}	8,5±0,22^{a}	7,64±0,24^{a}	21,71	<0,000
PFM	124,5±1,3^{ab}	109,18±1,83^{c}	129,5±1,75^{a}	120,33±0,21^{b}	80,87±0,22^{d}	77,14±2,29^{d}	128,2	<0,000
OPCM	168,47±1,5^{a}	157,81±1,9^{b}	172,66±1,8^{a}	167,77±2,1^{a}	125±2,31^{c}	121,85±2,47^{c}	109	<0,000

G I:Group I;G II:Group II;G III: Group III; G IV:Group IV; G V: Group V; G VI:Group VI; N: number of individuals, p < 0.0001:very highly significant;the averages followed by the same letter, in the same line are not significantly different according to the test from Newman-Keuls (Comparison joint committee); HT (cm): height of a seedling, LBV (cm): length of vegetative branch, LBF (cm): fruit-bearing length of branch, NN: numbers nodes, HNR (cm): height of internode, HPBF (cm): height of insertion of the first fruit-bearing branch, NPBF: node of insertion of the first fruit-bearing branch, NBF: numbers fruit-bearing branches, NBV: numbers vegetative branches, % CBF: percentage of bolls collected on the fruit-bearing branches, %CBV: percentage of bolls collected on the vegetative branches, RE: Output with shelling, IF: seed index, PFM: goes back to appearance average of the flowers, OPCM: goes back to average opening of the bolls

Table 5. Discriminating analysis based on the agromorphological characters

Variables	λ Wilk	Partiel λ	F	P	R	$(R)^2$
HT	0,028	0,786	13,639	< 0,001	0,429	0,571
LBV	0,026	0,837	9,754	< 0,001	0,842	0,158
HNR	0,023	0,947	2,771	0,019	0,403	0,597
NN	0,029	0,756	16,164	< 0,001	0,342	0,658
NBV	0,047	0,462	58,213	< 0,001	0,782	0,218
RE	0,024	0,906	5,173	< 0,001	0,885	0,115
SI	0,023	0,962	1,957	0,086	0,920	0,080
PFM	0,024	0,910	4,958	< 0,001	0,558	0,442
OPCM	0,025	0,874	7,181	< 0,001	0,660	0,340

HT (cm): height of a seedling, LBV (cm): length of vegetative branch, LBF (cm): fruit-bearing length of branch, NN: numbers nodes, HNR (cm): height of internode, HPBF (cm): height of insertion of the first fruit-bearing branch, NPBF: node of insertion of the first fruit-bearing branch, NBF: numbers fruit-bearing branches, NBV: numbers vegetative branches, % CBF: percentage of bolls collected on the fruit-bearing branches, %CBV: percentage of bolls collected on the vegetative branches, RE: Output with shelling, IF: seed index, PFM: goes back to appearance average of the flowers, OPCM: goes back to average opening of the bolls

This indicates a very strong heterogeneity between the accessions for these five characters. Moreover, some characteristics such as mean date of first flower appearance (PFM), average opening date of the first capsule (OPCM), Seed index (SI), ginning yield (RE), height of main stem (HT), length of the longest vegetative branch (LBV), number of nodes on the main stem (NN) and number of vegetative

crop populations (Mckeye *et al.,* 2001 Delaunay *et al.,* 2008, Missihoun *et al.,* 2012). These agromorphological differences between accessions are often conceived and implemented by various evolutionary processes. Agroecosystems are likely to exert selection pressures on genotypes (Sadiki and Jarvis, 2005). This is also the case for anthropogenic pressures (Robert *et al.,* 2005).

Correlation between the variables studied

Analysis of the Pearson correlation matrix of the different traits studied shows a significant correlation (> 0.50) between a few pairs of characters (Table 2). There is a highly significant and positive correlation (0.94) between the insertion height of the first fruiting branch (IHFFB) and the insertion node of the first fruiting branch (INFFB). Similarly, there is a very highly significant and positive correlation (0.85) between the number of fruiting branches and the percentage of bolls on the fruiting branches on the one hand, and between the length of the fruiting branches (LFB) and the number of fruiting branches (NFB) on the other. There is a very highly significant and positive correlation (0.84) between the number of vegetative branches and the percentage of bolls on the vegetative branches. The strong and positive correlation (0.87) between the date of appearance of the first average flower (MDFFA and the opening of the first average bolls is the same. On the other hand, there is a negative and significant correlation (-0.85) between the percentage of bolls on the vegetative branches (% BVB) and the number of the fruiting branch (NFB). Finally, a strong negative and significant correlation (-0.84) was observed between the number of vegetative branch (NVB) and the percentage of bolls on the fruiting branches (% BFB).

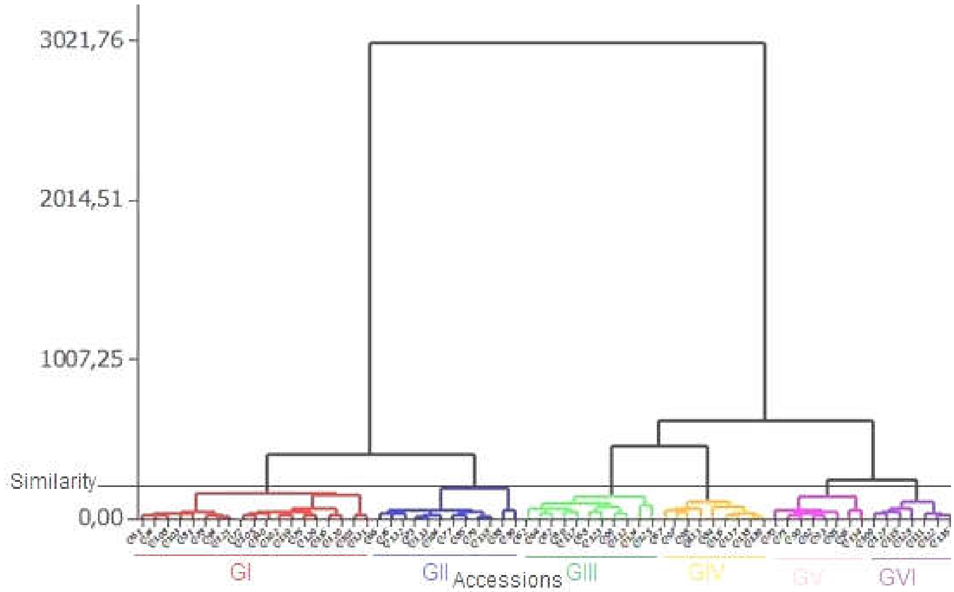
The results from Principal Component Analysis presented in Table 3 gave an estimate of the variability represented by each axis. The variance accumulation test shows that the first two axes are the most relevant. These two axes describe 72% of the total variability of accessions. The first axis describes 54% of the variation. This component is defined on the positive side by the length of the longest fructiferous branch (+0.32), the number of fruiting branches (+0.31), the percentage of bolls harvested on the fruiting branches (+0.34); and on the negative side by the number of vegetative branches and the percentage of bolls harvested on the vegetative branches (-0.34). Component 1 characterizes cotton accessions with numerous long fruit-bearing branches harboring the maximum number of bolls. The second component describes 19% of the variation. It is defined by the height of the internodes on the main stem (+0.34) and the yield at ginning (+0.32); which are positively correlated to the axis and negatively correlated by the insertion height of the first fructiferous branch (-0.37), the number of insertion nodes of the first fruiting branch (-0.38) and the date average opening of the bolls (-0.31).

These results showed that cotton plants whose insertion height of the first fruiting branch is high have a high number of insertion nodes of the first fruiting branch as well as a high number of fruiting branches and High percentage of bolls on the fruiting branches. Contrary to the results of Lançon *et al.* (2000), which stipulate that the precocity is an inverse function of the height, the correlation observed at the level of the cotton accessions between the total height of the plant and the precocity (opening of the bolls) indicating that the two parameters evolve in the same direction. In addition, cotton plants with many fructiferous branches also have more bolls on long fruiting branches. Concerning the cycle, the cotton plants having the date of appearance of the first early flower are characterized by an early opening of the bolls. On the other hand, cotton trees with more vegetative branches have very few fruiting branches and carry fewer bolls. The longer the cotton trees have long fruiting branches, the less they have vegetative branches with very few capsules and are late. If all these elements contribute to yield, then the number of fruit-bearing branches is positively correlated with yield (Khan *et al.,* 2010, Mustafa *et al.,* 2007 and Arshard *et al.,* 1993).

Analysis of the diversity of accessions by the ascending hierarchical classification

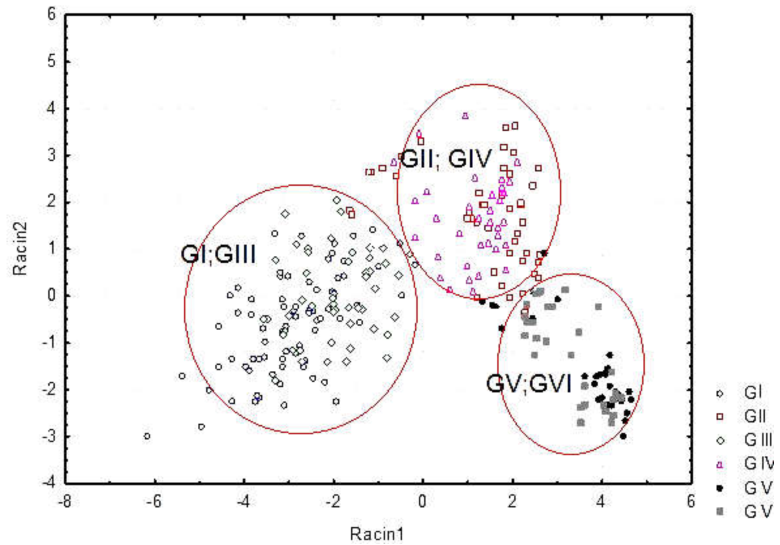
The dendrogram obtained by the Ward method based on the quantitative characteristics studied shows a clear separation of the 66 accessions and structures the diversity into six distinct groups (Figure 1). The first consists of 19 accessions (Q 61, Q, Q, Q, Q, Q, Q, Q, Q, Q, , The second of 11 accessions (Q 62, Q 64, Q 82, Q 80, Q 117, Q 68, Q 123, Q 99, The second group of 12 accessions (Q 66, Q 76, Q 132, Q 73, Q 133, Q 104, Q 77, Q 85, Q 79, Q 118, Q 88 and Q 89) The fourth of 9 accessions (Q 67, Q 97, Q 98, Q 113, Q 84, Q 136, Q 137, Q 138 and Q 139), the fifth and sixth groups respectively have 8 accessions , Q 90, Q 92, Q 93, Q 95, Q 96 and Q 114) and 7 accessions (Q 109, Q 127, Q 115, Q 128, Q 111, Q 122 and Q 135).

An analysis of variance carried out on the different subgroups resulting from the hierarchical classification made it possible to highlight the main distinctive characteristics. The mean values of the different groups are summarized in table 4. The first group is composed of 19 accessions (28, 79% of the total population) which are characterized by late cotton (PFM 125 ± 1.39 jas and OPCM 168 ± 1.5 jas) of very large size (257 ± 3.80 cm), with no fruiting branch, very numerous (32 ± 0.57) and long vegetative branches (110 ± 3.29 cm) harboring the whole Of the capsules (100 ± 1.55%), with a very high entrenched height (6 ± 0.21 cm). They had a low ginning yield (22 ± 0.64%) and small seeds (6 ± 0.14 g). Group II represents 16.67% of all accessions characterized by early cotton (PFM 109 ± 1.83 jas and OPCM 158 ± 1.97 jas), of large size (214 ± 5 cm), with Many (29 ± 0.67) and very long fructiferous branches (58 ± 2.03 cm). They have a number of insertion nodes of the first fruiting branch (15 ± 0.41) with very few vegetative branches (11 ± 0.76). They had low ginning yields (24 ± 0.84%) and small seeds (7 ± 0.19 g). Group III consists of 12 accessions (18.18% of the total population) which are characterized by very late cotton (PFM 129 ± 1.75 jas and OPCM 173 ± 1.88 jas) of large size (201 ± 4.79 cm), without fruiting branch. They have many (28 ± 0.72) and very long vegetative branches (84 ± 4.15 cm). All the capsules are found on the vegetative branches (100 ± 1.96%). They have a low ginning yield (24 ± 0.80%) and small seeds (6 ± 0.18 g). Group IV consists of 9 accessions (13.64% of the total population) which are characterized by late cotton (PFM 120 ± 0.21 jas and OPCM 167 ± 2.18 jas), large (144 ± 5.53 cm) with a high insertion height (66 ± 2.37 cm) and the insertion node number of the first very high fruiting branch (19 ± 0.45) The fruiting branch is of medium length (32 ± 2.24 cm) and the capsules are more distributed on the fruiting branches (55 ± 2.26%) than on the fruiting branches (25 ± 0.93%) and small seeds (7 ± 0.21 g), and group V is composed of 8 Accessions (12.12%), which are characterized by very early cotton plants (PFM 81 ± 0.22 jas and OPCM 125 ± 2.31 jas), small (132 ± 5.87 cm), with long fruiting branches (59 ± 2.38 cm) and very few vegetative branches (4 ± 0.89) very long (64 ± 5.08). They have nearly all the capsules on the fruiting branches (80 ± 2.40%) against (20 ± 2.40%) on the vegetative branches. The number of insertion nodes of the first fruiting branch is small (7 ± 0.48). They have a very high ginning yield (36 ± 0.99%) and large seeds (9 ± 0.22 g). Finally, group VI is composed of 7 accessions (10.61%) which are characterized by very early



G I:Group I;G II:Group II;G III: Group III; G IV:Group IV; G V: Group V; G VI:Group VI

Figure 1. Ascending hierarchical clustering (CAH) of the 66 accessions of cotton plant by the Ward method



G I:Group I;G II:Group II;G III: Group III; G IV:Group IV; G V: Group V; G VI:Group VI

Figure 2. Representation of the various groups in the canonical plan discriminating formed by the canonical components 1 and 2

cotton plants (PFM 77 ± 2.29 jas and OPCM 122 ± 2.47 jas) of large size (153 ± 6.27 Cm), with very long vegetative branches (117 ± 5.43 cm) and very long fruiting branches (59 ± 2.54 cm). They have capsules on both the fruiting branches (63 ± 2.56%) and the vegetative branches (37 ± 2.56%). They have a large number of fruiting branches (22 ± 0.83), with very few vegetative branches (5 ± 0.95) for a high ginning yield (30 ± 1.06%) and medium sized seeds (8 ± 0.24 g). Results showed that most of cotton accessions are considered vegetative and considered indeterminate to long cycle. Nevertheless, those of groups V and VI are very early. Cotton earliness is a quantitative characteristic that is mainly affected by the environment and crop genotype (Kassianenko *et al.,* 2003). Therefore, in any cropping system, selection of early cultivars is the main factor (Nichols *et al.,* 2004). The advantage of earliness of cotton varieties has been reported in Pakistan and other countries for the timely rotation of other crops for the wheat-cotton-wheat cropping system (Ali *et al.,* 2003). Precociousness is a trait sought by breeders and growers to escape unfavorable weather conditions, to avoid yield losses from disease and pest complexes (Singh, 2004). According to José Martin (2001), with an equal productivity, an early cultivar has lower requirements for seasonal length but increased during the season for water and mineral feeding and protection. Since production is more concentrated over time, nutrient flows must be higher, and any biotic or abiotic stress occurring in a given period will have a greater impact. Moreover, the accessions of groups I, II, III and IV being very vegetative and late, would have advantages when the abiotic conditions (compaction of soil, salinity, water stress) are unfavorable and disadvantages in case of excessive irrigation Or of density too high according to Bassett and Kerby (1996). Thus, Hearn (1995) recalls that long-cycle varieties (indeterminate) are more suited to drought (different water stress) than the varieties determined. Then, long cycle accessions can be used for areas of water deficit. According to Lançon *et al.* (2000), these criteria all have sufficient variability to be combined in specific selection strategies of the type sought. This makes these accessions a material of choice in cotton improvement and extension programs in Benin and in Africa.

Table 6. Coefficient of canonical function

Axes	F 1	F 2
Eigen value	6,594	1,472
Percentage of cumulated inertia	0,713	0,872
HT	-0,450	-0,522
LBV	0,056	0,266
HNR	0,134	0,411
NN	0,349	0,869
NBV	-0,746	-0,562
RE	0,050	-0,161
SI	0,132	-0,084
PFM	-0,121	0,427
OPCM	-0,221	0,460

HT (cm): height of a seedling, LBV (cm): length of vegetative branch, LBF (cm): fruit-bearing length of branch, NN: numbers nodes, HNR (cm): height of internode, HPBF (cm): height of insertion of the first fruit-bearing branch, NPBF: node of insertion of the first fruit-bearing branch, NBF: numbers fruit-bearing branches, NBV: numbers vegetative branches, % CBF: percentage of bolls collected on the fruit-bearing branches, %CBV: percentage of bolls collected on the vegetative branches, RE: Output with shelling, IF: seed index, PFM: goes back to appearance average of the flowers, OPCM: goes back to average opening of the bolls

Discriminant analysis

The discriminant analysis was carried out by using as a categorical variable the 6 groups obtained in the ascending hierarchical classification (CHA) to find the most discriminating variables with respect to the determined groups. The variables most contributing to the observed morphological variability are the height of the main stem (HT), length of the longest vegetative branch (LVB), number of nodes on the main stem (NN), number of vegetative branches (NVB), ginning outturn (GO), average date of the first flower (MDFFA) Opening of the first boll (AODFB). The Centered-Reduced Coefficients of the Canonical Discriminant Function are presented in Table 6. The first canonical function is the most important and explains more than 71% of the total variance and the second explains 5.9% of the total variance (Table 6). The analysis of this table also showed that the number of vegetative branches (NVB) is relatively well correlated on one side as on the other of axis 1. The characters height of the main stem (HT), height (HIP), number of nodes on the main stem (NN), average date of appearance of the first flower (MDFFA) and average opening date of the first boll (AODFB) Axis 2. Moreover, the graphical representation of discriminating canonical analysis (Figure 2) presents three major groups. It shows a grouping between the accessions of groups I and III, II and IV then V and VI.

Conclusion

The results on the diversity and agromorphological structure of the 66 cotton accessions in Benin on the basis of the 16 characters clearly showed that the accessions analyzed present an important variation for all the characters used, in particular those related to the fruiting branch, The vegetative branch, the insertion height of the first fruiting branch, the internode height and the ginning yield. This variability observed between accessions constitutes a real reservoir of genetic diversity, an argument of choice for the conservation of these cotton accessions. Characterization based on agromorphological criteria is certainly of great value for an efficient valorization, but should be supplemented by other more in-depth studies, in particular molecular techniques such as microsatellites, which will make it possible to better characterize the accessions inside Different groups. Finally, the introduction of these accessions into genetic reserves and their maintenance in situ will contribute to the preservation of genetic integrity and the adaptability of the material in order to avoid a scientific catastrophe.

Acknowledgement

This study was made possible by joint funding from the Center for International Cooperation in Agronomic Research for Development (CIRAD, France) and the Center for Agricultural Research Cotton and Fiber (CRA-CF, Benin) within the framework of A bilateral scientific collaboration.

REFERENCES

Adoukonou-Sagbadja, H., Wagner, C., Dansi, A., Ahlemeyer, J., Daïnou, O., Akpagana, K., Ordon, F., Friedt, W. 2007. Genetic diversity and population differentiation of traditional fonio millet (*Digitaria spp.*) landraces from different agro-ecological zones of West Africa. *Theor. Appl. Genet.,* 115: 917-31.

Aghaee, M., Mohammadi, R., Nabovati S. 2010. Agro-morphological characterization of durum wheat accessions using pattern analysis. *Aust J Crop Sci.,* 4: 505-514.

Ali, C.R., M. Arshad, M.I. Khan and M. Afzal. 2003. Study of earliness in commercial cotton (*G. hirsutum* L.) genotypes. *J. Res. Sci*., 14(2): 153-157.

Arshad, M., M. hanif, N.Ilahi and S.M. Shah. 1993. Correlation studies on some commercial cotton varieties of *G.hirsutum*. *Sarhad J. Agric.*, 9: 49-53.

Bassett, D.M. et T.A. Kerby. 1996. Varietal selection. In: Cotton production manual, publication 3352, S.Jhonson, K. Hake et al. (Eds). University of California, Oakland.

Beyene, Y., Botha, A.M., Myburg A.A. 2005. Phenotypic diversity for morphological and agronomic traits in traditional Ethiopian highland maize accessions. S. Afr. J. Plant Soil. S. Afr. Tydskr. Plant Grond 2005, 22(2).

Cauderon, A. 1986. Resources génétiques. Bull. Soc. bot. Fr 133, Actualities bot. 1986·1: 7 13.

CCIC. 2016. Comité Consultatif International du Coton. Bulletin d'information, Publié au début de chaque mois par le Secrétariat du Comité consultatif international du coton, 1629 K Street NW, Suite 702, Washington, DC 20006, Etats-Unis d'Amérique. Copyright © ICAC 2016-

Copur, O. 2006. Determination of yield and yield components of some cotton cultivars in semi-arid conditions. *Pak. J Biol. Sci.,* 9(14) 2572-2578.

Fournier, J. et Gurknecht J. 1991. Variabilité et héritabilité de la finesse standard Hs de la fibre de 6 cultivars de coton d'Afrique francophone. *Cot. Fib. Trop.* 46 (2) : 143-158.

Frankel, O., Brown, A.H.D., Burdon, J.J. 1995. *The conservation of plant biodiversity.* New York, USA: Cambridge University Press, 299 p.

Franquin, P. 1954. Importance et nature de la précocité chez les cotonniers Barbadense de la zone Guinéenne de l'Afrique Occidentale. *Cot. Fib. Trop.,* (1954): 72-86.

Harem, E. 2012. Guida, Tarim Ve Hayvancilk Bakanligi ; Yaym No : 73, pp 97

Harlan, J.R. 1987. Les plantes cultivées et l'homme traduit par Belliard, J. et Fraleigh, B. Coll. Techniques Vivantes publiée par l'ACCT. Presses Universitaire de France. 414 p.

Hearn, A.B. 1995. The principles of cotton water relations and their application in management. In: Challenging the future: Proc.World Cotton Res. Conf.-1.G.A. Constable and NW Forrester (Eds). CSIRO, Melbourne. Pp.66-92.

Kassianenko, V.A., Dragavtsev, V.A., Razorenov, G. I. and Razorenov T.S. 2003. Variability of cotton (*G. hirsutum* L.) with regard to earliness. *Genet. Resour. Crop Evol*., 50: 157-163.

Khan, A.I., Awan, F. S., Sadia, B., Rana, R. M., & Khan, I. A. 2010. Genetic diversity studies among coloured cotton genotypes by using RAPD markers. *Pak. J. Bot.,* 42(1): 71-77.

Kirankumar Reddy, C. 2004. Studies on laboratory techniques for identification of cotton (*Gossypium* spp.) genotypes. *M. Sc. (Agri.) Thesis,* Acharya N. G. Ranga Agric. Univ., Hyderabad (India).

Lançon, J., Sêkloka, E., Hougni, A., Djaboutou, M. 2000. Réduction de taille et augmentation de précocité sont-elles compatibles avec l'amélioration génétique de la productivité? Actes des journées Coton du Cirad, Cirad, Montpellier.

Lhuillier, J. 1950. Le coton en A.O.F.: les possibilités de production et le programme des recherches envisagées par l'IRCT. *Cot. Fib. Trop.,* 3 : 107-120

Mandal, S.M., D. Chakraborty and Gupta, K. 2008. Seed Size variation: Influence on germination and subsequent seedling performance in *Hyptis suaveolens* (Lamiaceae). *Res. J. Seed Sci*., 1: 26-33.2008

Marchenay Philippe et Marie-France Lagarde 1987. A la recherche des variétés locales de plantes cultivées Guide méthodologique PAGE PACA 1987 ISBN: 2-9501451-0-8. 126p.

Martin, J. 2001. Variétés déterminées ou indéterminées: comment les définir et les utiliser ? Acte des journées coton, Montpellier 23 et 24 juillet 2001.

Mckeye, D., Emperaie, L., Elias, M., Pinton, F., Robert, T., Desmoulière, S., Rival, L. 2001. Gestions locale et dynamiques régionales de la diversité variétale du manioc en amazonie. Genet. Sel. Evol. 33:465-490.

Mendez del Villar, P., Alvez, R.A., Keita, M.S. 2006. Facteurs de performance et de compétitivité des exploitations cotonnières au Brésil, aux états-Unis et au Mali. *Cah. Agric.* 15, p. 23–34.

Missihoun, A.A., Agbangla, C., Adoukonou-Sagbadja, H., Ahanhanzo, C., Vodouhè, R. 2012. Gestion traditionnelle et statut des ressources génétiques du sorgho (*Sorghum bicolor* L. Moench) au Nord-Ouest du Bénin. *Int. J. Biol. Chem. Sci*., 6:1003-1018.

Moustafa, A., Elsheikh, Y.M.A and Babiker, E.A. 2007. Genetic variability and character association and selection criteria in cotton (G. hirustmin) *Sudan J.Agric.Res*., 8:43-50.

N'da, H.A., Akanvou, L., Kouakou, K.C., Zoro, A.I.B. 2014. Diversité morphologique des variétés Locales de maïs (*zea mays* L.) collectées au centre et centre-ouest de la Cote d'ivoire. *Eur. Ci. J*., 12(10): 349-365.

Nichols, S.P., Snipes, C.E. and Jones, M.A. 2004. Cotton growth, lint yield and fiber quality as affected by row spacing and cultivar. *J. Cotton Sci*., 8: 1-12.

Radhouane, L. 2004. Etude de la variabilité morphophénologique chez *Pennisetum glaucum* (L.) R. Br. Plant Genet. *Resourc. Newslett*., 138:18-22.

Robert, T., Mariac, C., Allinne, C., Ali, K., Beidari Y., Bezançon, G., Couturon, E., Moussa, D., Sasou, M.S., Seydou, M., Seyni, O., Tidjani, M., Luxereau, A. 2005. Gestion des semences et dynamiques des introgressions entre variétés cultivées et entre formes domestiques et spontanées des mil (*Pennisetum glaucum ssp. glaucum*) au Sud-Niger. In: Un dialogue pour la diversité génétique. Paris: BRG, 2005, (5), pp: 555- 573. (Les Actes du BRG; 5). Colloque National du BRG: Un Dialogue pour la Diversité Génétique, 5. ISBN 2-908-447-33-9.

Sadiki, M., Jarvis, D. 2005. Conservation in situ de la diversité génétique des cultures par sa gestion à la ferme dans les agroécosystèmes marocains. Les Actes du BRG 5:445-464.

Seignebos, C. and Scwendiman, J. 1991. Les cotonniers traditionnels du Cameroun. *Cot. Fib. Trop.,* Vol. 46 (4). 309-322.

Sié, M. 1998. Prospection des cuItivars traditionnels de riz du Burkina Faso. Revue CAMES Volume N° 00 – 1998. 7p.

Singh, P. 2004. Cotton Breeding. 2nd Ed., Kalyani Pub. New Delhi, India, pp. 118.

Smith, S.E., Doss, A.A., Warburton, M. 1991. Morphological and agronomic variation in North African and Arabian alfalfas. Crop Sci. 31:1159-1163.

UPOV. 2001. Union internationale pour la Protection des Obtentions Végétales, 2001-04-04 TG/88/6 Cotton, Guidelines for the conduct of tests for distinctness, uniformity and stability, COTTON (*Gossypium* L.), Geneva 2001 26p.

****