International Journal of Current Research in
Biosciences and Plant Biology
Volume 4 • Number 5 (May-2017) • ISSN: 2349-8080 (Online)
Journal homepage: www.ijcrbp.com

Original Research Article **doi:** https://doi.org/10.20546/ijcrbp.2017.405.002

Ethnobotanical Investigation and Collection of the Local Maize (*Zea mays* L.) Varieties Produced in Benin

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Abstract

Although maize is an economic crop among agroecological zones in Benin, there is a limited information on its varietal diversity, production constraints and ethnobotanical knowledge. To fill this gap, ethnobotanical survey was conducted among 51 communities from 22 ethnic groups randomly selected from 11 departments in Benin using participatory rural appraisal. A total of 161 accession names of maize were recorded and collected from the study area. Results of the study showed a strong correlation between the age of the producers and the number of varieties produced. Similarly, there was a relationship between total maize yield produced and size of the farm cultivated. In the North, maize varieties are classified based on seed color or maturity period, while in the South plant morphology and origin are mostly used. Across ethnic groups, variety preference criteria depended on specific production constraints and its socio-cultural importance. Based on the perceived agronomic traits of the varieties reported by farmers, collected samples were clustered into four groups of complementary characteristics that are of high importance for maize breeding in Benin.

Article Info

Accepted: 27 March 2017
Available Online: 06 May 2017

Keywords

Diversity
Maize varieties
Production constraint
Yield

Introduction

Maize (*Zea mays* L.) is an important crop in the world. Globally, an estimated 1.038 billion tons was produced in 2014 (FAO, 2016). Compared with wheat and rice, it is estimated to provide about 30% of the total nutritional calories of almost 94 countries in the developing world (Shiferaw et al., 2011). It is also an important source of animal feed and serves as raw material for several agro based industries (Boone et al., 2008; Shiferaw et al., 2011; Badu-Apraku et al., 2014). Since its introduction to West Africa, it has progressed to become an economic crop with several varieties developed for different agro-ecological zones (Badu-Apraku et al., 2014). In Benin, it is cultivated in all the agro-ecological zones and plays an important role in the country's economy. Production is characterized by small holder farmers with farm size ranging between 0.5 and 2 ha. Increase in productivity has been attributed to increased production area and not mainly due to the use of improved inputs. The national production is estimated at about 1.1 million tons cultivated on an area of 938,845.7 ha (Countrystat, 2014). The low yield can be attributed to several factors such as poor edaphic conditions, bad agronomic practices and most importantly the use of poor quality seed which is due to

lack of uniformity planting material. Seeds play a pivotal role in agricultural productivity and the breeding for good quality seed for use by farmers depends on basically on understanding, identification, collection and utilization of diverse germplasm in breeding programs. Within countries, several maize varieties are in circulation with different names produced by farmers for several reasons apart from yield (Manda et al., 2016).In Cote d'Ivoire for instance some varieties such as the purple maize cultivated at Katiola and surrounding localities (Kouakou et al., 2010) are produced due to its socio-cultural importance. Due to the lack of a well-established national maize germplasm collection centers and standardized names for these varieties, farmers serves as both producers and biodiversity conservationist holding on to diverse maize varieties. They also serve as a repository of knowledge in determining and differentiating between maize varieties in their possession. In order to benefit from their knowledge resource, this study was conducted to document some maize accessions in Benin, the different accession names, origin of accession names, characteristics of maize farmers, production practices and constraints encountered among various ethnic groups in all agro-ecological zone of Benin where maize is produced. Specifically, the study sought to:

- Document the status of the existing local maize varietal diversity and the agronomic characteristics of the varieties.
- Document some production practices associated with maize production in the study areas.
- Assess some biotic and abiotic constraints associated with maize production in the study areas.
- Prioritize farmers' varietal preference criteria for breeding purposes.

Materials and methods

Study area and site selection

The study was conducted among 51 ethnic groups (Table 1) located in eight agro-ecological zones (Fig. 1) and 11 administrative departments of the country. Of the 11 administrative departments surveyed, 4 (Atacora, Donga, Alibori and Borgou) were located in the North, 1 (Collines) in the Centre and 6 (Zou, Oueme, Plateau, Mono, Couffo and Atlantique) in the South. The north has a single rainfall season with annual rainfall between 700 and 900 mm with an average temperature of between 28°C and 50°C (Hell et al., 2000; Adomou, 2005; Akoègninou et al., 2006; Loko et al., 2013).

AEZ II and AEZ III, found in the cotton zone of Northern Benin and the food-producing zone of Southern Borgou respectively falls under the Sudan climate condition with a mean rainfall of 900 to 1300 mm and a temperature range of between 28 to 40°C annually (Hell et al., 2000). West Atacora zone located in AEZ IV falls in the Sudan transition zone and experiences a mean annual rainfall of between 800 and 1400mm. However, AEZ V (Central Benin), AEZ VI (Zone of Bar Ground), AEZ VII (Zone of Depression) and AEZ VIII (Zone of Fisheries) are characterized with two rainy seasons with annual rainfall of 1100 and 1400 mm and mean annual temperatures of between 25 and 35°C. The collection of maize varieties included two to five municipalities per department. The municipalities were not only chosen proportionately to the maize production in each department during the cycle of production but also as a function of ethnic groups' repartition in the department. When prospective zone was not reached for target villages, cultivated territory of each municipality has been considered. Therefore, fifty one villages were investigated in proportion of one to three villages per municipality (Table 1).

Table 1. List of villages surveyed their departments, municipalities and ethnic groups.

N°	Villages	Municipalities	Departments	Ethnic groups
1	Adjantè	Bantè	COLLINES	Ifè
2	Aïzè	Ouinhi	ZOU	Fon
3	Alafiarou	Tchaourou	BORGOU	Bariba
4	Atokolibé	Bantè	COLLINES	Ifè
5	Awokpa	Zè	ATLANTIQUE	Aïzo
6	Bassila-Allan	Bassilla	DONGA	Annii
7	Béléfoungou	Djougou	DONGA	Yom
8	Bétérou	Tchaourou	BORGOU	Bariba

N°	Villages	Municipalities	Departments	Ethnic groups
9	Cotiakou	Tanguiéta	ATACORA	Wama
10	Coussin-lélé	Covè	ZOU	Mahi
11	Dendougou	Djougou	DONGA	Yom
12	Dévé	Dogbo	COUFFO	Adja
13	Dogbo-kounacho	Adja-ouèrè	PLATEAU	Holli
14	Dogo	Kétou	PLATEAU	Mahi
15	Domè	Zogbodomè	ZOU	Fon
16	Dovi-Zounou	Zangnanado	ZOU	Mahi
17	Fô-bouré	Sinendé	BORGOU	Bariba
18	Fô-Tancé	Kouandé	ATACORA	Bariba
19	Founougo	Banikoara	ALIBORI	Bariba
20	Gativé	Comé	MONO	Watchi
21	Gobè	Savè	COLLINES	Idaatcha
22	Gouti	Adjohoun	OUEME	Wémé
23	Guézo-houé	Kpomassè	ATLANTIQUE	Sahouè
24	Handin-sota	Dangbo	OUEME	Wémé
25	Hokpamè	Athiémé	MONO	Adja
26	Houéda	Adjohoun	OUEME	Wémé
27	Houinga-Houégbé	Houéyogbé	MONO	Sahouè
28	Kodowari	Bassilla	DONGA	Annii
29	Koni	Nikki	BORGOU	Bariba
30	Kpassabéga	Copargo	DONGA	Yom/Tanika
31	Lagbavé	Aplahoué	COUFFO	Adja
32	Lougou	Ségbana	ALIBORI	Boo
33	Madécali	Malanville	ALIBORI	Dendi
34	Madjavi	Djidja	ZOU	Fon
35	Mitro	Dangbo	OUEME	Wémé
36	Monkpa	Savalou	COLLINES	Mahi
37	N'dahonta	Tanguiéta	ATACORA	Natimba
38	Obi-cro	Savalou	COLLINES	Mahi
39	Pélima	Kouandé	ATACORA	Bariba
40	Piami	Ségbana	ALIBORI	Boo
41	Sam	Kandi	ALIBORI	Bariba
42	Sanrin-Kpinlè	Sakété	PLATEAU	Wémé
43	Sèkèrè	Sinendé	BORGOU	Bariba
44	Sèmèrè	Ouaké	DONGA	Foodo
45	Sérékali	Nikki	BORGOU	Bariba
46	Sinawongourou	Kandi	ALIBORI	Bariba
47	Sowé	Glazoué	COLLINES	Mahi
48	Tandji	Lalo	COUFFO	Adja
49	Tapoga	Cobly	ATACORA	Gnidé/gountéma
50	Toffo-centre	Toffo	ATLANTIQUE	Aïzo
51	Toubougnini	Matéri	ATACORA	Berba

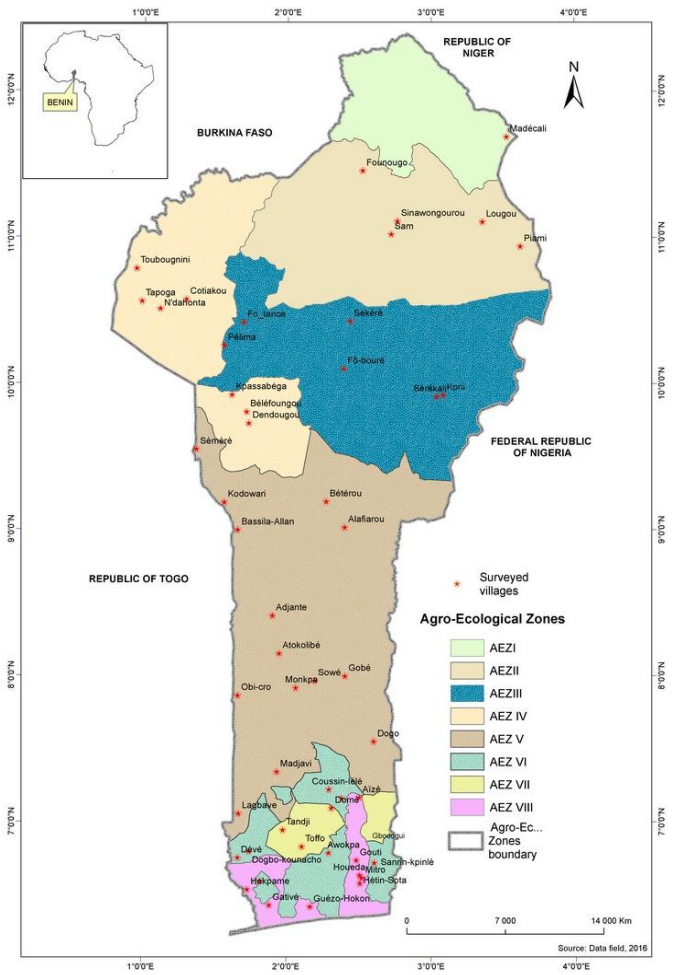

Fig. 1: Benin map showing the agro-ecological zones and the geographic positions of villages surveyed.

Selection of respondents

The total number of respondents were selected using the normal approximation of binomial distribution method (Dagnelie 1998):

The formulae used was $N = [(U_{1-\alpha/2})^2 \times p(1-p)]/d^2$,

Where $U_{1-\alpha/2}$ is the value of the random normal variable for the value of probability of 1- α/2, α is the risk of error. For α = 5%, the probability 1- α/2 = 0.975 and we have $U_{1-\alpha/2}$ = 1.96; p is proportion of people involved in maize production in studied area and d the range of error estimation at 5% in this study (Dagnelie, 1998). A total of 1006 farmers were selected for the survey.

Survey and data collection

A survey was conducted from May to June 2014. With the help of semi-structured questionnaires, both quantitative and qualitative data were collected from the respondents. In each village, focus group discussions were carried out with the help of a local translator. Each focus group was made up of between 20 to 30 maize farmers. Farmer in each group submitted samples of different maize varieties grown in the locality. Based on this, the varieties of maize grown by the farmers were obtained. Also based on a PRA assessment, farmers ranked different production constraints linked to maize production in their village. The identified constraints were ranked based on their severity as described by Orobiyi et al. (2013). Data were also collected on the local name of each variety, the maturity period of each accession, color and shape of maize seed, origin, yield potential, tolerance to drought and resistance to pest and disease as observed by farmers.

Individual survey included 10 to 35 producers taken in different households selected in each village was investigated according to Dansi et al. (2010). Similarly, socio-demographic characteristics such as sex, age, educational level, number of years maize production, farm size, membership or not to farmer association of the farmers were collected. Finally farmer's production practices, sources of seeds, their knowledge of availability of improved varieties, and reasons for choosing and planting a particular variety were also collected.

Data analysis

Data collected were analyzed using the XLSTAT 2016 software after it has been organized and coded using the spread sheet of Microsoft Excel. Tables and figures were used to display the results of the analyzed data as described by Kisauzi et al. (2012). The production constraints reported were analyzed based on the total number of villages/groups (NTV) in which the constraint was cited, the top 5 principal constraints (PCO) reported among the groups/villages and the number of villages where the constraint is major and is rated first (MAC).

Thus, the importance of a constraint was determined by the formula IMC = (NTV + PCO + MAC) / 3. The relationship between socio-demographic parameters (gender, age, level of education, years of experience in maize production, farm size) and existing varietal diversity was determined using the Pearson correlation coefficient. Using the Ward aggregation method, the

diversity between accessions were revealed by the Hierarchical Ascending Classification (HAC) while considering maize accessions as individuals and the parameters to be evaluated as variables.

Results

Names assigned to maize specie and varieties by producers

It was observed that maize accessions were assigned different names among the communities. Even among the same community different names were assigned to accessions (Table 2). Among the Bariba community, located in AEZ II and AEZ III, the same maize accession was identified with 2 different names (Gbadénou, Gbèrénou) whilst in Fon in the AEZ VIII, it was identified with 2 names (Gbadé, Agbadé). The naming of the accessions were also observed to be influenced by different factors such as its origin ("Awonli gbayé koun" which means "Maize of Nigeria"), maturity period of the accession ("Sègê yoladji" which means "three-month maize") and seed colour or morphology ("Kougan" meaning "coarse grains") (Fig. 2). Whilst communities in AEZ I named their varieties based on number of days to mature and origin of the accession, farmers in all the remaining AEZ used more than 2 factors to name a particular accession (Fig. 2).

Table 2. Different names of maize specie given by different ethnic groups.

N°	Ethnic group	Species name
1	Adja	Bafo
2	Aïzo	Gbaa, Gbadé
3	Annii	Artchéfounon, Arana
4	Bariba	Gbadénou, Gbèrénou
5	Berba	Baiya
6	Boo	Mancé
7	Dendi	Agbado
8	Fon	Gbadé, Agbadé
9	Foodo	Amonboyo
10	Gnidé/gountéma	Segyoudi, Abadiyo
11	Holli	Gbadé
12	Idaatcha, Ifè	Gbado
13	Mahi	Gbadé, gbado
14	Nago	Agbado
15	Natimba	Sègê
16	Sahouè	Yovokouin
17	Wama	Manan so
18	Watchi	Ebli
19	Wémè	Agbayé,Gbayé, Gbadé
20	Yom	Manzô
21	Tanika	Paaza

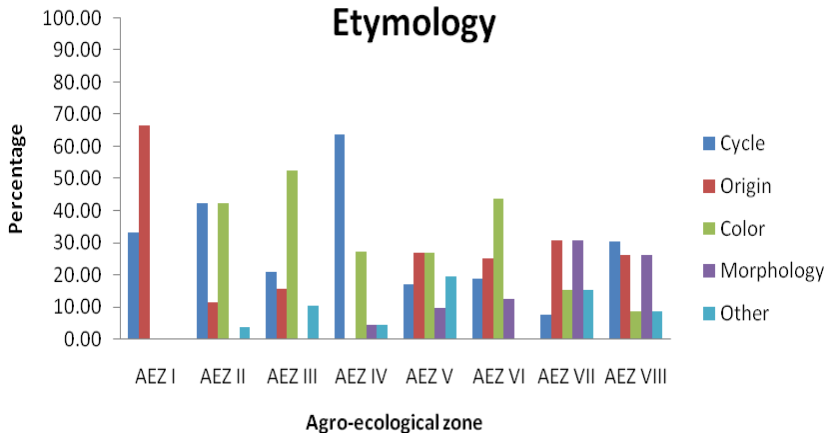

Fig. 2: Etymology of local names of varieties of maize per zone of production.

Origin and diversity of maize in the various study villages

Subject to synonymy, a total of 161 maize accessions/ names were recorded from the 51 villages surveyed. It was observed that 93.2% and 6.8% were local and exotic (introduce) accessions respectively. With respect to the total maize accessions, 56.8% were improved varieties and had been received by the producers through various research centers whilst 43.2% of the materials were not certified as improved varieties (Fig. 3). The results also showed the low adoption of improved varieties among the farmers. Results of the survey across the various AEZs showed that majority of the maize accessions produced by farmers were of local origin and not introduced from different countries (Fig. 3). Similarly, most of the farmers were found to be producing unimproved (traditional) varieties as against improved varieties developed from various research centers (Fig. 3). The number of farmers using improved varieties ranged between 7.3% and 17.4% among farmers in AEZ II, AEZ V, AEZ VII and AEZ VIII (Fig. 3). Based on visual/morphological examination such as maize cobs, grains size and shapes diversity were observed in the maize accessions (Fig. 4).

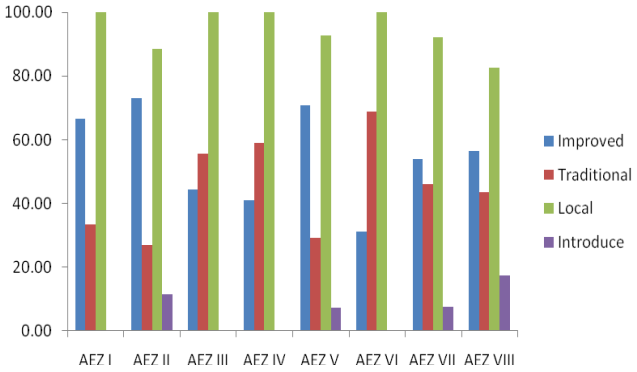

Fig. 3: Origin and status of varieties of maize collected in Benin.

Fig. 4: Diversity between the maize accessions collected in Benin.

Analysis of diversity by the ascending hierarchical classification

An ascending hierarchical classification (AHC) was performed on the basis of six characters considered per variety during the collection phase. The dendrogram obtained by the Ward aggregation method (minimization of intra-class variance) separated the accessions into four (4) clusters (Fig. 5). The dominant accession identified in each of the groups resulting from this classification is presented in Table 5. Accessions in Cluster 1, comprised 11.7% of the total number of accessions analyzed, and consisted of accessions with low grain yield, tolerance to drought, agronomic growth performance on marginal soil and susceptibility to storage pest according to farmers perceptions. Accessions in cluster 2, representing 20.99% of the total accessions, were characterized with high grain yield, drought tolerance, resistant to storage pest within a year of storage and good agronomic growth performance on marginal soil. In contrast to accessions in cluster 2, accessions in cluster 3 with 61.11% of total accessions were highly susceptible to storage pest with poor agronomic growth performance on marginal soil. Finally, accessions in cluster 4 representing 6.2 % of total accessions were found to produce the highest grain yield and were highly resistant to storage pest for a period of up to 5 years. Clusters 2 and 4 accessions can therefore be used as a gene donor for the improvement the other clusters accession, to allow them have high resistance to storage insects, good grain yield and good agronomic performance on marginal soils. The distance between the bary centres of clusters 2 and 3 was found to be the least (1.995) showing that these two clusters are closer while the highest distance (5.431) was obtained between clusters 1 and 4 (Table 4).

The variances between the different characteristic of each accession was found to be low. The variances ranged between 1.881 and 2.418 for cluster 4 and cluster 1 respectively (Table 3). The λ Wilk test performed revealed good yield, reaction to storage pest and good agronomic performance on marginal soil (zero and good) as the main characteristics distinguishing between the accessions (Table 6). There was a highly significant difference between the clusters (p<0.0001) based on these variables. In general, the number of identified accessions per trait according to farmer varied between 1 for a varieties' mean maturity period (4 and 6 months) to 147 for resistance to lodging (Fig. 6). Also, all accessions identified, clustered into four main groups based on the cluster analysis and 91 accessions units were identified (Table 7). It was also observed that each unit had a specific characteristic which separated it from other units in the same group. The number of unit per group was 15, 22, 47, and 7 for cluster 1, 2, 3 and 4 respectively. The number of accessions per unit also varied from one to nine (Tables 7a, 7b, 7c and 7d).

Table 3. Repartition of accessions into four groups and distances related to their bary center.

Group	Number	Intra-group variance	Minimal distance to bary center	Mean distance to bary center	Maximal distance to bary center
G1	19	2.418	0.537	1.387	2.786
G2	34	1.965	0.746	1.330	2.874
G3	99	2.291	0.705	1.377	3.728
G4	10	1.881	0.695	1.238	2.164

Table 4. Distance to bary center of groups.

Groups	G1	G2	G3	G4
G1	0			
G2	3.265	0		
G3	2.192	1.995	0	
G4	5.431	4.587	4.576	0

Table 5. Dominant accession of four groups obtained from the AHC.

Group (Accessions)	Cyc	Prod	DT	RV	RSI	PPS
1 (Mandésourouita)	3	0	0	1	0	1
2 (Manzo tchroitama)	3	2	1	1	1	3
3 (Arana wétchéfounon)	3	2	1	1	0	1
4 (Agbayésouaton ton)	3	2	0	1	5	1

NB: **Cyc**: cycle in month, 3 = 3 months; **Prod**: productivity, 0 = low, 2 = good; **DT**: drought tolerance, 0 = sensitive, 1 = tolerant; **RV**: Resistance to verse, 1 = resistant; **RIS**: resistance to storage insects, 0 = sensitive, 1 = resistant for 1 year, 5 = resistant for 5 years; **PPS**: performance on poor soil, 1 = low, 3 = good

Table 6. One-dimensional test of Wilks.

Variable	Lambda	F	DF1	DF2	*p*-value
Prod	0.755	17.127	3	158	< 0.0001
Res Ins sto	0.832	10.653	3	158	< 0.0001
Perf on poor soil	0.369	90.245	3	158	< 0.0001

DF- Degree of freedom

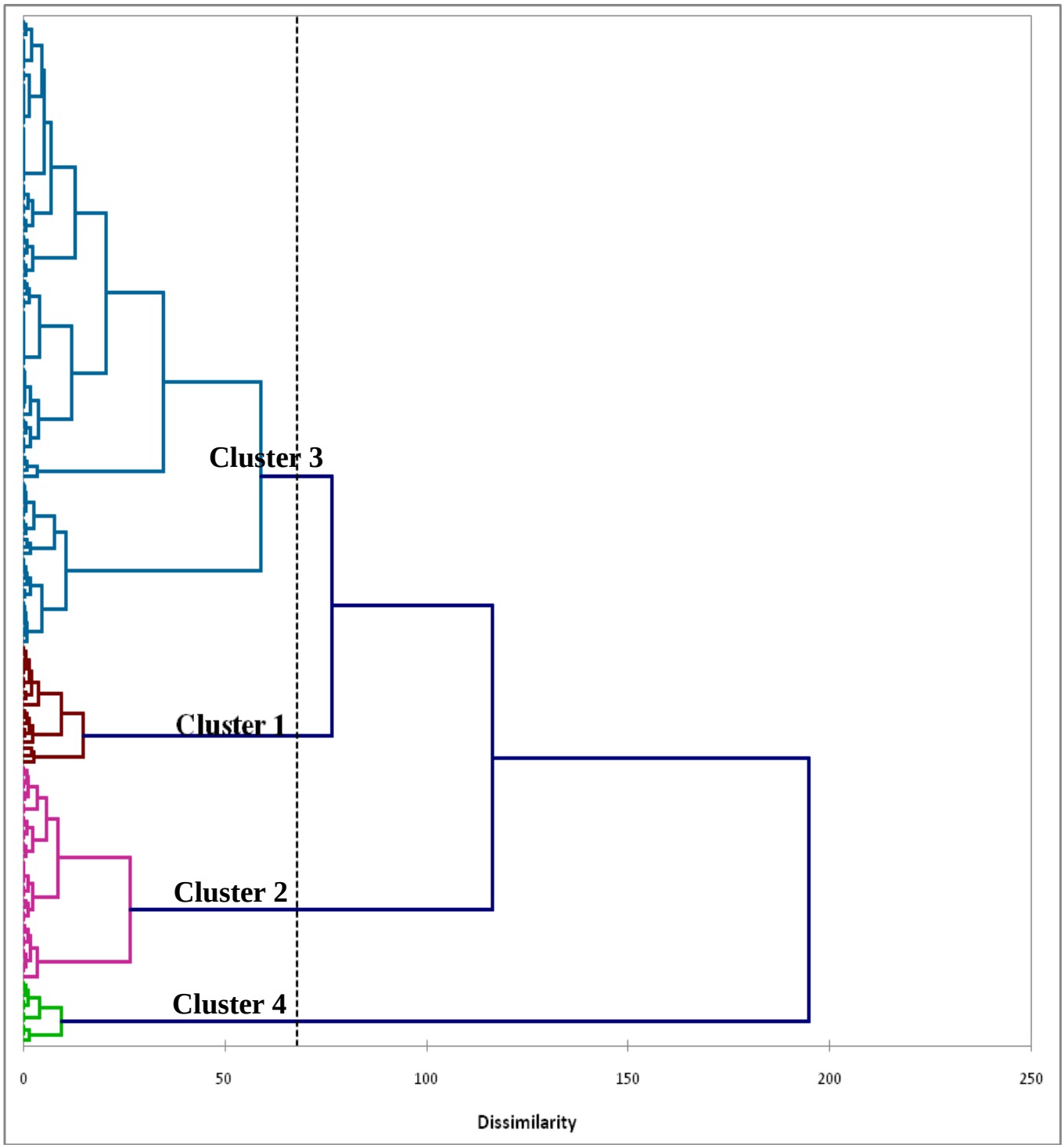

Fig. 5: Hierarchical cluster of 161 accessions collected in Benin following the Ward aggregation method.

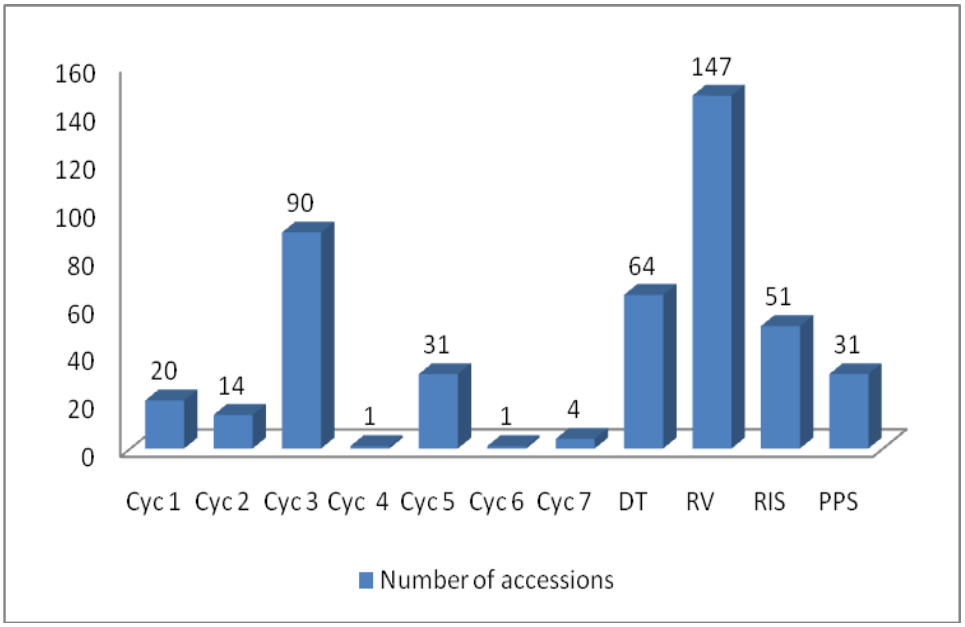

Fig. 6: Number of identified accessions per trait according to farmer's perception. Cyc: mean maturity period of production; Cyc 1: 2 months; Cyc 2: 2.5 months; Cyc 3: 3 months; Cyc 4: 3.5 months; Cyc 5: 4 months; Cyc 6: 5 months; Cyc 7: 6 months; DT: drought tolerance; RV: resistance to verse; RIS: Resistance to insect storage; PPS: performance on poor soil.

Table 7a: Number of unit derived from first group of cluster analysis.

Unit	Num of acc.	List of accessions and relative productivity
U1	2	Gbè kékégou (L); Gouvé (L)
U2	3	Gbè chouannou (L); mandé souan (L); QPM (L)
U3	2	Mandé sourouita (L); Gbayé-Koungli (L)
U4	1	Wlétchivékou (L)
U5	1	Mananso tèrè (L)
U6	1	Mancé monplana 1 (L)
U7	1	Ségê yonika (L)
U8	1	Manzo tchroinès (L)
U9	1	Agbado carder (L)
U10	1	Agbadé carder (L)
U11	1	Sourounin (L)
U12	1	Mandé sourouinin (L)
U13	1	Lingbonoukoun (L)
U14	1	Gbogbouin (L)
U15	1	Mancé mon aon (L)

Num of acc.: number of accessions; L: Low; relative productivity is in bracket.

Table 7b: Number of unit derived from second group of cluster analysis.

Unit	Num of acc.	List of accessions and relative productivity
U1	2	Manzo tchroitama 2 (G); Agbadé ADF (G)
U2	2	Artchéfounon ranan (G); Congo (G)
U3	1	Gbogbouin (G)
U4	1	Tavèkoun (G)
U5	1	Bafokougan (G)
U6	1	Enouatin (G)
U7	2	QPM (H); Shishi (H)
U8	2	Segyoudi wingnita (G); agbado carder (G)

Unit	Num of acc.	List of accessions and relative productivity
U9	2	Gbèsouan (G); Taala (G)
U10	1	Baiya béenirou (G)
U11	4	Manzo tchroitama (H); mancé tian (H); Gbayé souaton (H); Carder bafo (H)
U12	2	Gbayé souaton ton (H); Allaba (H)
U13	1	Kounado (H)
U14	1	Gbadé souwoué adadé (H)
U15	2	Carder blidjin (H); Carder blihéé (H)
U16	1	Gbadé vôvô (G)
U17	1	Mancé monplana 2 (H)
U18	2	Tchankpo (H); gbaa-Vèè (H)
U19	1	Gbadé souwoué adadé (G)
U20	1	Ebrydji (G)
U21	2	Mandé souan (G);Gbadé Tchankpo (G)
U22	1	Yokouin sahouèton (M)

Num of acc.: number of accessions; G: good; H: high; M: medium; relative productivity is in bracket.

Table 7c. Number of unit derived from third group of cluster analysis.

Unit	Num of acc.	List of accessions and relative productivity
U1	2	Ohouya (G); Wlétchivékou (G)
U2	1	Kokourôkpètè (M)
U3	4	Sèwaga djimamadè (G); Bétérou1 (G); Sourouigou (G); Wlétchivékou (G)
U4	1	Pisaback (G)
U5	2	Hybride (G); Gbado kpikpa (G)
U6	7	Arana wètchéfounon (G); Artchéfounon(G) ikinka (G); Sèwaga djiomatin (G); Alafiarou1 (G); Sourouita2 (G); Mandé kpika (G); Coopérative (G)
U7	9	Baiya bépipialéci (G); Abadiyoyê (G); Sègê yoladji 1 (G); Gbè kpikounou (G); Gbè souannou (G); Fonkoun (G); Gbado carder (G); Unknown (G); Carder bli (G)
U8	3	Artchéfounon carder (TZPB) (G); Artchéfounon fonnon 1 (H); Sourouita1 (H)
U9	2	Mandésouan (H); Sourouirou (H)
U10	2	Gbadé souaton (H); Djongbô (H)
U11	1	Goun-koun (H)
U12	2	Baiya Bétouinzi (G); Kotokoli kouaré (G)
U13	2	Baiya Bélaaci (H); Sègê yoladji 2 (H)
U14	2	Paaza cri ita (H); Amomboyo okano (H)
U15	1	Mananso kpodé (H)
U16	1	Agrique (H)
U17	1	Artchéfounon fonnon 2 (H)
U18	1	Agbayé sounènin (H)
U19	2	Sac faaba (H); Gbado dani (H)
U20	9	Artchéfounon eworonam (G); Amomboyo ognilassa (G); Gbadénou bacadou (G); sourounin (G); Gbèkpika (G); mandé nouakoro (G); mandé kpika (G); Agbayé-kounga (G); Agbayé souènè (G)
U21	2	Amonboyo bankam (G); Ibride (G)
U22	5	Paaza moala (G); Gbédé chouannou (G); Gando (G); gbado sassakawa (G); Gbado ognibo (G)
U23	1	Gbadé Agongba (M)
U24	2	Paaza cri inès (G); Sourounèmè (G)
U25	1	Sèwaga manahin (G)
U26	3	Sourouigou (G); macépoua (G); DMR (G)
U27	1	mandé bisouan (G)
U28	1	Amomboyo onlè (G)
U29	1	mandé numbertia (H)
U30	1	Artchéfounon egboumbonnon (H)
U31	1	Massahoué (G)
U32	2	Gbadé vè1 (G); Gbadé vè2 (G)
U33	2	Agor (G); Kpoléhoun (G)
U34	2	Ehrini (G); Awouévi (G)
U35	1	Awonli gbayékou (M)

Unit	Num of acc.	List of accessions and relative productivity
U36	1	Agbadé gboo (G)
U37	1	Djikoun (G)
U38	1	Gbado carder (G)
U39	3	Kotokoli tchèrè (G); Gbadé Agonlikpahoun (G); Bogan (G)
U40	1	Pozarica (G)
U41	1	Akpayibô (M)
U42	1	Gangbakoun (G)
U43	1	Yayi boni 2 (G)
U44	2	Gouvè (G); Adjakouin (G)
U45	2	Yayi boni 1 (G); Unknown 3 (G)
U46	2	Unknown 1 (G); Ennindjéré (G)
U47	1	Awouébli (G)

Num of acc.: number of accessions; G: good; H: high; M: medium; relative productivity is in bracket.

Table 7d. Number of unit derived from fourth group of cluster analysis.

Unit	Num of acc.	List of accessions and relative productivity
U1	2	Ikpetchi (G); Otchoukpamè (G)
U2	1	Gbado otchoublihoun (H)
U3	2	Agbayé souaton ton (G); Otchoukpamèta (G)
U4	1	Macé tingnan (G)
U5	1	Gbérénou (G)
U6	2	Gbadé vôvô 1 (H); Gbadé vôvô 2 (H)
U7	1	Grégoire (H)

Num of acc.: number of accessions; G: good; H: high; relative productivity is in bracket.

Constraints to maize production in the villages surveyed

The Maize producers prioritized their constraints based on intensity, frequency and importance for which an urgent solution was needed (Table 8a). In majority (87.5%) of the agro-ecological zones surveyed, poor soil fertility and the unavailability of agrochemical input were the prominent constrains to production (Table 8b). Similarly, the lack of good quality seeds and destruction of produce by insect pests, were also identified as major threat to maize production in the study area.

The problem of agricultural input was mainly related to the high cost of fertilizers (NPK and urea) or difficulty in accessing them.

Table 8a. Principal constraints of maize production in Benin.

Constraints	TNV	PCO	MAC	% IMC
Soil infertility	41	41	34	**31.52**
Chemical input lack	40	40	4	**22.83**
Lack of rain/drought	25	24	6	**14.95**
Insufficiency of good quality seed	23	22	1	**12.50**
Insects attack	10	10	2	**5.98**
Adventice	9	9	0	4.89
Flooding	7	7	1	4.08
Attack of stem borers	6	6	0	3.26

Table 8b. Principal constraints of maize production in each agro-ecological zone.

Constraints	AEZ1	AEZ2	AEZ3	AEZ4	AEZ5	AEZ6	AEZ7	AEZ8
Soil infertility	0	1	1	1	1	1	2	1
Chemical input lack	1	2	2	2	3	2	1	3
Lack of rain/drought	0	6	6	4	2	3	4	4
Insufficiency of good quality seed	0	3	3	3	4	5	5	5
Insects attack	0	4	x	x	6	4	3	6
Adventice	0	5	4	5	5	6	x	x
Flooding	2	x	x	6	x	x	6	2
Attack of stem borers	0	7	5	x	7	7	x	x

NB: x = constraint non cited

Reasons for the selection and use of varieties by farmers

It was observed that farmers considered several factors in selecting maize varieties to produce (Table 9). Given the constraints listed in the different AEZs, selection factors varied from one AEZ to another. However, the three main factors considered in selecting a particular variety as observed across the 8 AEZs were the potential yield the maturity period and soil conditions. In addition, depending on the production conditions of each zone, factors such as, drought tolerance, and resistance to storage pest were considered in the choice. Thus, given the environmental factors, some producers (78.65%) preferred early-maturing accessions because it allowed them to farm twice within a year whilst others chose them because it helped them to avoid the drought period or the short-lived rainy season recorded in some AEZs. However, in AEZs I, II and III, yield and maturity period were the most important criteria considered in selecting a variety (Table 9). Although yield was an important factor in selecting a variety, it was found to be dependent on an accessions tolerance to certain factors such as drought and performance on non-fertile soil. The market demand for a variety was also found to influence the selection and production of a variety (Table 9).

Maize is also subjected to qualitative and quantitative post-harvest losses due to pests attack. Then, according to high destruction of seed after harvest and during conservation a lot of producers included resistance to stocks 'insects attack in their criteria' choice list.

Table 9. Selection criteria of varieties produced by farmers.

Criterion of production	AEZ I	AEZ II	AEZ III	AEZ IV	AEZ V	AEZ VI	AEZ VII	AEZ VIII	Mean
Yield	3	3	3	3	3	3	3	3	3
Cycle	3	3	3	2	2	2	1	2	2.25
Performance on poor soil	0	1	0	1	2	3	3	3	2.17
Drought tolerance	0	2	2	2	1	0	0	0	1.75
Resistance to storage insects	1	1	1	0	1	3	2	3	1.71
Demand of market	2	1	1	0	1	2	2	2	1.57
Cooking quality	0	1	0	2	1	1	1	1	1.17

Sociodemographic characteristics of the maize producers surveyed

The mean age of the respondents was 43 years ± 9.083. The majority (91.7 %) of producers were men, with 8.3% of them being women. Based on their ages, the farmers were grouped into four main classes. Thus, 10.44% of the respondents were below 30 years old (class A); 32.41% were between 31 and 40 years of age (class B). A percentage of 39.26% of the respondents were at least 41 years old and up to 50 years old (class C); then 17.89% of the respondents were at least 51 years old (class D) (Fig. 7). This classification was justified by a discriminant analysis which confirmed that 99.40% of the grouped individuals were well classified in their group (Fig. 7). Very few of the producers (20.38%) were members of any peasant association group. The producers were characterized with a low level of education. It was observed that 71.87% had no formal education, 20.28% had completed basic education with only 7.85% completing receiving secondary education. The number of years spent in maize production by a producer varied between 2 years and 40 years with an average of 12.07 years ± 6.14. A variation of 0.125 to 20 ha and 0.2 to 25 ha was respectively obtained for an area planted with maize and a total area planted by producers in each village with a mean of 1.95 ha ± 1.72 and 4.65 ha ± 2.98 (Table 10). The analysis of these different mean shows a strong positive correlation between the age of the respondents and the number of years in production and the number of varieties planted (Table 11). There was also a positive correlation between farm size and land availability to the farmer. There was however a low correlation between all the other parameters studied (Table 11).

Table 10. Description of each group of age identified.

Group of age	Experience	Cultivated maize area (ha)	Total area (ha)	Number of varieties
A	7	1.3	3.4	1
B	10	1.8	4.2	1
C	13	1.9	4.8	2
D	18	2.6	5.8	2

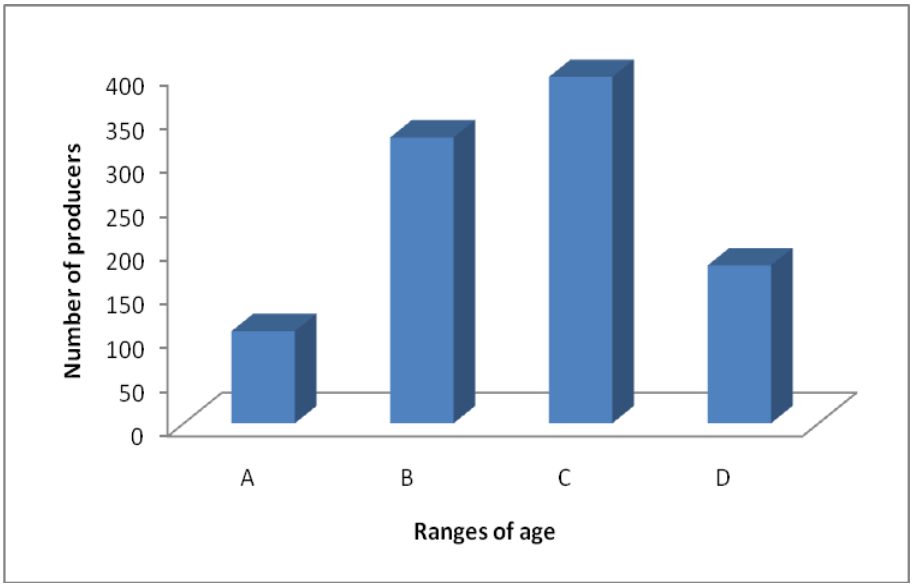

Fig. 7: Total number of producer per group.

Table 11. Correlation between socio-demographic parameter.

Variables	Age (year)	Experience	Cultivated maize area (ha)	Total cultivated area	Number of variety
Age (year)	1				
Experience	**0.587**	1			
Cultivated maize area(ha)	0.212	0.196	1		
Total cultivated area	0.256	0.202	**0.771**	1	
Number of variety	**0.416**	0.268	0.286	0.234	1

Agronomic Practices

Maize is the most consumed cereal in Benin. A percentage of 64.51% of farmers noted a growth of its production. The study revealed that majority (90.85%) of maize farmers' had adopted various techniques for preserving their seed. Of these, 79.87% of them selected good looking seeds and stored in bags either with or without winnowing plus treatment with chemicals such as sofagrain, temephos, and DD force to avoid destruction by storage pests. Some (11.93%) stored in earthen drums filled with corn kernels and ash or chili pepper whilst others stored by tying corn spathes to the ceiling of kitchens. Only 31.71% of respondents soaked seeds in water as pre-emergence treatment to accelerate germination. Planting was done on ridges mainly due to issues such as poor soil fertility (32.81%), ease of tillage (39.65%) and increase in yield potential (18.75%). The number of seeds per hill varied among farmers in various localities and ranged from 1 to 4 seeds/hill.

Most (35.88%) of the farmers practiced mixed cropping. Maize was intercropped with crops such as cassava, sorghum, soybean, millet, cowpea, earth pea, groundnut, sesame or even yam.

It was also observed that 54.87% of the farmers applied fertilizer (NPK and Urea) on their field with varied application time. More than half (56.16%) of the farmers applied the fertilizer 15 days after planting (DAP) while remain applied it 30 DAP. The application rate was also found to differ among the farmers as 67.39% applied 150 kg / ha, (100 kg / ha of NPK and 50 kg / ha of urea) while 32.61% applied 200 kg / ha, (150 kg / ha. Kg / ha of NPK and 50 kg / ha of urea). Depending on the rainfall pattern maize planting was carried out from June to August in the northern departments of AEZ I, II, and III, which are characterized by a single rainy season. In the central and southern part of the country where two major planting seasons are possible, planting was done between May - July, and February - April. The early maturing maize varieties were produced in the south in the month of March to avoid the drought season experienced.

Discussion

Maize adapts to a wide range of edapho-climatic conditions. It is produced in all the agro-ecological zones of Benin Republic and most especially likes soils with a light structure, deep and easy to cultivate

(Adégbola and Aloukoutou, 2011). The identification of maize varieties by seed color, seed size or maturity period as observed in the current study corroborates the work of several authors in Mexico (Soleri and Cleveland, 2001; Brush and Perales, 2007) and Togo (Adoukonou-Sagbadja et al., 2006) were farmers used similar traits to distinguish between varieties. The results of the current study also confirms the finding of others authors (Sawadogo and Balma, 2003; Jiro et al., 2011) that agro-morphological characters are easily used to distinguish between varieties among rural farmers. The low adoption rate clearly shows the slow adoption rate by farmers which could be due to the high rate of farmers with no formal education and involvement of many aged farmers, although the older farmers possess many years of experience and hold on a great diversity of maize accession. The poor adoption could also be attributed to the limited information and extensions services available to farmers or lack of access to these improved varieties. The socio-cultural value associated with some local accessions may have contributed to the continual production of these materials compared to the improved materials.

The constraints listed by farmers during this study are similar to constraints reported in several countries such as Kenya (Odendo et al., 2001) and Ivory Coast (N'da et al., 2013). The poor fertility of soil across the various AEZ according to Pingali and Pandey, (2001), is due to the intensive use of lands and the rapid decrease of fallow'. To compensate for the loss of fertility, the right application of fertilizer at the right time and rate is encouraged. It was however observed that NPK and urea application rate was low and poorly timed. The addition of legumes in the cropping system was therefore justified as these legumes are reported to improve soil conditions and nutrient status by fixing nitrogen. The availability and use of good quality seeds is an important in input for agricultural development (Aly and Padonou, 2007; Achigan-Dako et al., 2014). The high use of unimproved seeds as revealed in the study could have contributed to the poor yield recorded by the farmers. According to Achigan-Dako et al. (2014), seeds contribute about 40% in yield potential of several crops. In all the AEZs of Benin, seed quality and quantity were reduced by post-harvest storage pest. The lack of standardized system of storing seeds contributed significantly to post harvest loss and according to Arouna (2011) storage pests contributes to the massive destruction of seeds hence reduces the availability of planting materials, encourages use of unimproved seeds. This is due to high cost of improved materials and thereby increasing cost of production and reducing farm incomes (Arouna et al., 2011) which also affects food security (Affognon et al., 2000). The qualities of seeds were however considered as a factor in selecting maize variety only when it was intended for consumption and not for market. This clearly shows the limited information available to farmers on the importance of seed quality in maize production.

Although 161 maize accessions/names were collected, they clustered into 4 main groups. The groupings of the accessions shows the relatedness of these varieties across the various ethnic groups although each ethnic group had special names assigned to them. Each of the groups had qualities that influenced the naming of the material. Notwithstanding the unique qualities of each group, accessions in Group 2 were found to possess certain desirable traits which can useful in future breeding programs.

Conclusion

This study identified 161 accessions of maize grown in the 51 selected villages. The names of these varieties were found to be based on mean maturity period, seed color, seed shape of the ear, morphology of the plant, and the origin of the variety. Due to degradation of crop soils and climatic variability, production of this crop is subject to constraints including soil infertility which undermines its potential yield. Farmer's selected maize variety based production constraint encountered in their locality to reduce the impact of the stress. The various traits used by farmers in selecting varieties for their locality/AEZ can serve as a basis for developing improved materials suitable for those areas. Thus, for better conservation and utilization of this existing diversity, it will be important to achieve agro-morphologic assessment of these different accessions collected. This assessment combined to their genetic diversity study by the use of molecular markers could help in synonymies clarification and duplicates should be identified. Otherwise, identify the varieties possessing target genes (example of gene related to soil fertility) will be useful in a molecular breeding program.

Conflict of interest statement

Authors declare that they have no conflict of interest.

Acknowledgement

This study was sponsored by the Benin component of the West Africa Agricultural Productivity Program (WAAPP). We gratefully acknowledge the valuable assistance of the technicians of the laboratory of Biotechnology, Genetic Resources and Animal and Plant Breeding (BIORAVE) of the Faculty of Science and Technology of Dassa (Benin).

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How to cite this article:
Bonou-gbo, Z., Djedatin, G., Dansi, A., Dossou-Aminon, I., Odjo, C. T., Djengue, W., Kombate, K., 2017. Ethnobotanical investigation and collection of the local maize (*Zea mays* L.) varieties produced in Benin. Int. J. Curr. Res. Biosci. Plant Biol. 4(5), 9-29. **doi:** https://doi.org/10.20546/ijcrbp.2017.405.002

Appendix - I: Etymology and characteristics of accessions of maize collected in Benin.

N°	Accessions	Etymology	Cyc	Col	Ori	Prod	DT	RV	RIS	PPS
1	Abadiyoyê	White maize	3	White	Carder	Good	No	Yes	No	Low
2	Agbadé ADF	Maize of ADF	3	White	ONG ADF	Good	Yes	Yes	1 year	Good
3	Agbadé carder	Maize of carder	4	White	Carder	Low	No	Yes	No	Low
4	Agbadé gboo	Maize producing a lot	3	White	Madjavi	Good	Yes	No	2 years	Middle
5	Adjakouin		2.5	White	Madjavi	Good	No	Yes	1 year	Low
6	Agbado carder	Maize of carder	5	White	Carder	Low	No	Yes	No	Null
7	Agbado carder	Maize of carder	3	White	Carder	Good	Yes	Yes	No	Middle
8	Agbayé souaton ton	Maize of three months	3	White	Carder	Good	No	Yes	5 years	Low
9	Agbayé souènè	Maize of four months	4	White	Carder	Good	No	Yes	No	Low
10	Agbayé-kounga	Long cobs maize	4	White	Carder	Good	No	Yes	No	Low
11	Agor	Ceremonies	2	White	Aïzè	Good	No	Yes	2 years	Low
12	Agrique	Project	4	White	Carder	Very good	No	No	No	Low
13	Akpayibô	Black spathe	3	White	Lokossa market	Middle	Yes	Yes	1 year	Low
14	Alafiarou1	Unknown	3	White	Carder	Good	Yes	Yes	No	Low
15	Allaba	Long cobs Maize	3	White	Hetin-sota	Very good	Yes	No	No	Good
16	Amomboyo ognilassa	Maize of four months	4	White	Sèmèrè	Good	No	Yes	No	Low
17	Amomboyo okano	Maize of three months	3	White	Carder	Very good	Little	Yes	No	Null
18	Amomboyo onlè	Maize of six months	6	White	Sèmèrè	Good	No	Yes	No	Low
19	Amonboyo bankam	Small maize	2.5	Yellow	Sèmèrè	Good	No	Yes	No	Null
20	Arana wètchéfounon	Maize of three months	3	White	Carder	Good	Yes	Yes	No	Low
21	Artchéfounon carder (TZPB)	Maize of carder	3	Blanche	Carder	Very good	Yes	Yes	No	Low
22	Artchéfounon egboumbonnon	Big maize	6	White	bassila-allan	Very good	Yes	Yes	No	Good
23	Artchéfounon eworonam	Maize of four months	4	White	Carder	Good	No	Yes	No	Low
24	Artchéfounon fonnon (1)	White maize	3	White	Carder	Very good	Yes	Yes	No	Low
25	Artchéfounon fonnon (2)	White maize	4	White	Carder	Very good	Yes	Yes	No	Low
26	Artchéfounon ikinka	Red Maize	3	Yellow	Carder	Good	Yes	Yes	No	Low
27	Artchéfounon ranan	Red maize	3	Yellow	Carder	Good	Yes	Yes	No	Good
28	Awonli gbayékoun	Maize of Nigeria	3	White	Nigéria	Middle	No	Yes	3 years	Low
29	Awouébli	From our home	3	White	Gativé	Good	No	No	1 year	Low
30	Awouévi	From our home	3	White	Lokossa market	Bonne	No	Yes	3 years	Low
31	Bafo kougan	Gross grain maize	3.5	White	Dévé	Good	No	No	1 year	Good
32	Baiya béenirou	Maize of four months	4	White	Carder	Good	No	Yes	No	Middle
33	Baiya Bélaaci	Maize of three months	3	White	Carder	Very good	Little	Yes	No	Low
34	Baiya bépipialéci	Maize multicoloured	3	Multicoloured	Toubougnini	Good	No	Yes	No	Low
35	Baiya Bétouinzi	Red maize	3	Yellow	Toubougnini	Good	Little	Yes	No	Low
36	Bétérou1	-	2	White	Carder	Good	Yes	Yes	No	Low
37	Bogan	Great surface	3	White	Lagbavé	Good	Yes	Yes	1 year	Low
38	Carder bafo	Maize of carder	3	White	Carder	Very good	Yes	Yes	No	Good

N°	Accessions	Etymology	Cyc	Col	Ori	Prod	DT	RV	RIS	PPS
39	Carder bli	Maize of carder	3	White	Carder	Good	No	Yes	No	Low
40	Carder blidjin	Red Maize of carder	2	Yellow	Carder	Very good	Yes	Yes	No	Good
41	Carder blihéé	White maize of carder	2	White	Carder	Very good	Yes	Yes	No	Good
42	Carder1	Carder	3	White	Carder	Good	No	Yes	No	Low
43	Carder2	Carder	3	White	Carder	Low	No	Yes	No	Null
44	Congo	-	3	Multicoloured	Sinanwongourou	Good	Yes	Yes	No	Good
45	Coopérative	Gift of carder	3	White	Carder	Good	Yes	Yes	No	Low
46	Djikoun	Rainy seeds	3	White	Aïzè	Good	Little	Yes	2 years	Middle
47	Djongbô	Giant	3	White	Lokossa market	Very good	No	Yes	No	Low
48	DMR	DMR	3	White	Carder	Good	Yes	Yes	No	Null
49	Ebrydji	-	2	White	Togo	Good	No	Yes	2 years	Good
50	Ehrini	Quick maize	3	Yellow	Obi-Cro	Good	No	Yes	3 years	Low
51	Ennindjéré	Maize of two months	2	White	Madécali	Good	No	Yes	1 year	Low
52	Enouatin	Eat stem	4	Multicolored	Tandji	Good	No	No	1 year	Good
53	Fonkoun	Seeds of fon	3	White	Aïzè	Good	No	Yes	No	Low
54	Gando	Peuhl	4	White	Bariba	Good	No	Yes	No	Null
55	Gangbakoun	Multicolored maize	4	Multicolored	Awokpa	Good	Yes	Yes	1 year	Low
56	Gbaa-Vèè	Red maize	3	Yellow	Awokpa	Very good	No	Yes	2 years	Good
57	Gbadé Agongba	Maize that overtops a garret	3	White	Dogo	Middle	No	No	No	Null
58	Gbadé Agonlikpahoun	Maize of agonlikpahoun	3	White	Dogo	Good	Yes	Yes	1 year	Low
59	Gbadé souaton	Maize of three months	3	White	Carder	Very good	No	Yes	No	Low
60	Gbadé souwoué adadé	Maize of two months and half	2.5	White	Carder	Very good	No	Yes	No	Good
61	Gbadé souwoué adadé	Maize of two months and half	2.5	Yellow	Guézo-hokon	Good	No	Yes	2 years	Good
62	Gbadé Tchankpo	Maize producing a lot	3	White	Dogo	Good	No	Yes	2 years	Good
63	Gbadé vè1	Red maize	3	Red	Sanrin-kpinlè	Good	No	Yes	2 years	Low
64	Gbadé vè2	Red maize	3	Yellow	Sanrin-kpinlè	Good	No	Yes	2 years	Low
65	Gbadé vôvô	Red maize	3	Yellow	Dovi-zounou	Good	Yes	Yes	2 years	Good
66	Gbadé vôvô 1	Red maize	2.5	Yellow	Coussin-lélé	Very good	Yes	Yes	5 years	Middle
67	Gbadé vôvô 2	Red maize	3	Yellow	Coussin-lélé	Low	Yes	Yes	5 years	Low
68	Gbadé noubacadou	Maize of four months	4	White	Carder	Good	No	Yes	No	Low
69	Gbado wéwé	Maize white	3	White	Carder	Good	Little	Yes	3 years	Low
70	Gbadodani	Maize of Dani	4	White	Sowé	Very good	No	Yes	No	Null
71	Gbado kpikpa	Red maize	3	Yellow	Carder	Good	Yes	No	No	Low
72	Gbado ognibo	White maize	3	White	Carder	Good	No	Yes	No	Null
73	Gbado otchoublihoun	Maize of four months	4	White	Carder	Very good	No	Yes	5 years	Low
74	Gbado sassakawa	Sassakawa project	3	White	Carder	Good	No	Yes	No	Null
75	Gbayé souaton	Maize of three months	3	White	Carder	Very good	Yes	Yes	No	Good
76	Gbayé souaton ton	Maize of three months	3	White	Carder	Very good	Yes	No	No	Good
77	Gbayé-Koungli	Small cobs maize	2.5	White	Carder	Low	No	Yes	No	Low

N°	Accessions	Etymology	Cyc	Col	Ori	Prod	DT	RV	RIS	PPS
78	Gbè chouannou	Red maize	3	Multicoloured	Bariba	Low	No	Yes	No	Null
79	Gbè kékégou	Multicoloured maize	2.5	Multicoloured	Bariba	Low	No	Yes	No	Null
80	Gbè kpika	White maize	4	White	Bariba	Good	No	Yes	No	Low
81	Gbè kpikounou	White maize	3	White	Bariba	Good	No	Yes	No	Low
82	Gbè souan	Red maize	3	Red	Sinanwongourou	Good	No	Yes	No	Middle
83	Gbè souannou	Red maize	3	Yellow	Bariba	Good	No	Yes	No	Low
84	Gbé déchouannou	Red maize	3	Yellow	Fô-tancé	Good	No	Yes	No	Null
85	Gbérénou	Red maize	3	Red	Bariba	Good	Yes	Yes	5 years	Null
86	Gbogbouin (1)	Yellow maize	2	Multicolored	Lagbavé	Low	No	No	No	Good
87	Gbogbouin (2)	Yellow	3	Yellow	Toviklin	Good	No	Yes	No	Good
88	Goun-koun	Seeds of Goun	3	White	Mitro	Very good	No	Yes	1 year	Low
89	Gouvè	Red maize	2.5	Yellow	Carder	Good	No	Yes	1 year	Low
90	Gouvè	Red seed	2	Yellow	Carder	Low	No	Yes	No	Null
91	Grégoire	Fields are good	3	Yellow	Hetin-sota	Very good	Yes	No	5 years	Good
92	Hybride	Hybrid	3	White	Carder	Good	Yes	No	No	Low
93	Ibride	Hybrid	2.5	White	Carder	Good	No	Yes	No	Null
94	Ikpetchi	Maize of Ikpetchi	4	White	Atokolibé	Good	No	Yes	5 years	Low
95	Igbado funfun	White maize	3	White	Monkpa	Good	No	Yes	No	Low
96	Igbado Ochoumedji	Maize of two months	2	White	Carder	Good	No	Yes	No	Low
97	Igbado Ochoumèta	Maize of three months	3	White	Carder	Good	No	Yes	1 year	Low
98	Kokourôkpètè	Gathering by chicken	2	White	Togo	Middle	No	Year	No	Low
99	Agbado kouaré	White maize	3	White	Carder	Good	Little	Yes	No	Low
100	Agbado tchèrè	Red maize	3	Red	Carder	Good	Yes	Yes	1 year	Low
101	Kounado	Seeds	2	White	Carder	Very good	No	No	No	Good
102	Kpoléhoun	debt-holder waiting for me	2	White	Carder	Good	No	Yes	2 years	Low
103	Lingbonoukoun	Eye of she-goat	2.5	Black	Coussin-lélé	Low	Yes	Yes	1 year	Middle
104	Macépoua	White maize	3	White	Carder	Good	Yes	Yes	No	Null
105	Macétingnan	Red maize	2.5	Yellow	Carder	Good	Yes	Yes	1 year	Null
106	Manan so kpodé	White maize	3	White	Carder	Very good	Yes	Yes	No	Null
107	Manan so tèrè	Red maize	2.5	Red	Tanguiéta	Low	Yes	Yes	No	Null
108	Mancé mon aon	Maize of four months	4	White	Carder	Low	No	Yes	No	Good
109	Mancé monplana (1)	Maize of three months	3	White	Carder	Low	No	Yes	2 years	Null
110	Mancé monplana (2)	Maize of three months	3	White	Carder	Very good	Yes	Yes	2 years	Good
111	Mancé tian	Red maize	3	Yellow	Carder	Very good	Yes	Yes	No	Good
112	Mandé bisouan	Red maize	6	Red	Sam	Good	Yes	Yes	No	Low
113	Mandé kpika	White maize	4	White	Carder	Good	No	Yes	No	Low
114	Mandé numbertia	Maize of six months	6	White	Carder	Very good	Yes	Yes	No	Low
115	Mandé sourouinin	Maize of four months	4	White	Founougo	Low	Little	Yes	No	Null
116	Mandé sourouita	Maize of three months	3	White	Carder	Low	No	Yes	No	Low

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117	Mandé kpika	White maize	3	White	Carder	Good	Yes	Yes	No	Low
118	Mandé nouakoro	Multicolored maize	4	Multicolored	Sam	Good	No	Yes	No	Low
119	Mandé souan	Red maize	3	Red	Sinanwongourou	Good	No	Yes	2 years	Good
120	Mandé souan	Red maize	3	Red	Sam	Low	No	Yes	No	Null
121	Mandé souan	Red maize	2	Yellow	Congo	Very good	Yes	Yes	No	Low
122	Manzo tchroinès	Maize of four months	4	White	Dendougou	Good	Yes	Yes	No	Null
123	Manzo tchroitama	Maize of three months	3	White	Carder	Very good	Yes	Yes	No	Good
124	Manzo tchroitama (2)	Maize of three months	3	White	Carder	Good	Yes	Yes	1 year	Good
125	Massahoué	Save home	2.5	Yellow	Houéda	Good	No	Yes	2 years	Low
126	Ohouya	Quickly	2	White	Dogbo-kounacho	Good	No	Yes	No	Low
127	Otchoukpamè	Maize of three months	4	White	Carder	Good	No	Yes	5 years	Low
128	Otchoukpamèta	Maize of three months	3	White	Carder	Good	No	Yes	5 years	Low
129	Paaza cri inès	Maize of four months	4	White	Copargo	Good	Yes	Yes	No	Null
130	Paaza cri ita	Maize of three months	3	White	Copargo	Very good	Little	Yes	No	Null
131	Paazamoala	Red maize	3	Yellow	Copargo	Good	No	Yes	No	Null
132	Pisaback	Small maize	2.5	White	Carder	Good	Yes	Yes	No	Low
133	Pozarica	Project	3	White	Carder	Good	Yes	Yes	2 years	Low
134	QPM	QPM	3	White	Carder	Very good	Yes	Yes	No	Middle
135	Sac faaba	Maize that produces a lot	4	White	Tapoga	Very good	No	Yes	No	Null
136	Sègê yoladji (1)	Maize of three months	3	Red	Peulh	Good	No	Yes	No	Low
137	Sègê yoladji (2)	Maize of three months	3	White	Carder	Very good	Little	Yes	No	Low
138	Ségê yonika	Maize of four months	4	White	N'dahonta	Low	No	Yes	No	Null
139	Segyoudi wingnita	Maize of three months	3	White	Carder	Good	Yes	Yes	No	Middle
140	Sèwaga djimamadè	Small red maize	2	Red	Pelima	Good	Yes	Yes	No	Low
141	Sèwaga djiomatin	White maize	3	White	Carder	Good	Yes	Yes	No	Low
142	Sèwaga manahin	Purple maize	4	Purple	Pelima	Good	No	Yes	No	Null
143	Shishi	Tight seeds	3	White	Toviklin	Very good	Yes	Yes	No	Middle
144	Sounènin gbadé	Maize of four months	4	White	Aïzè	Very good	No	Yes	No	Low
145	Sourouigou	Maize of three months	3	White	Carder	Good	Yes	Yes	No	Null
146	Sourouirou	Maize of two months	2	White	Carder	Very bad	Yes	Yes	No	Low
147	Sourouirou (2)	Maize of two months	2	White	Carder	Very good	Yes	Yes	No	Null
148	Sourouita (1)	Maize of three months	3	White	Unknown	Very good	Yes	Yes	No	Low
149	Sourouita (2)	Maize of three months	3	White	Unknown	Low	Yes	Yes	No	Low
150	Sourounèmè	Maize of four months	4	White	Carder	Good	Yes	Yes	No	Null
151	Sourounin	Maize of four months	4	White	Bariba	Good	No	Yes	No	Low
152	Sourounin	Maize of four months	4	White	Carder	Low	Yes	Yes	No	Low
153	Taala	Field Protector	3	Red	Toviklin	Good	No	Yes	No	Middle
154	Tavèkoun	Guinean pepper	3	Yellow	Nigéria	Good	No	Yes	1 year	Good
155	Tchankpo	Very strong maize	3	White	Dogbo-kounacho	Very good	No	Yes	2 years	Good

N°	Accessions	Etymology	Cyc	Col	Ori	Prod	DT	RV	RIS	PPS
156	Wlétchivékou	Seeds of two months	2	White	Carder	Low	Yes	Yes	No	Low
157	Wlétchivékou	Seeds of two months	2	White	Carder	Good	No	Yes	No	Low
158	Wlétchivékou 2	Seeds of two months	2	White	Carder	Good	Yes	Yes	No	Low
159	Yayi boni (1)	Gift of Yayi Boni	3	White	Carder	Good	No	Yes	1 year	Low
160	Yayi boni (2)	Gift of Yayi Boni	4	White	Carder	Good	No	Yes	1 year	Low
161	Yokouin sahouèton	Maize of sahouè	3	Multicolored	Sahouè	Middle	No	No	3 years	Good

Legend: Cyc: Cycle in months; **Col**: Color; **Ori**: Origin; **Prod**: Productivity; **DT**: drought Tolerance; **RV**: Resistance to verse; **RIS**: Resistance to insects storage; **PPS**: Performance on poor soil.