



ISSN: 2230-9926

International Journal of Development Research  
Vol. 07, Issue, 01, pp.10897-10901, January, 2017

## Full Length Research Article

### CODIFICATION AND MORPHOLOGICAL CHARACTERIZATION OF THE LOCAL VARIETIES OF CORN (*ZEA MAYS L.*) OF CHAD IN WAY OF EXTINCTION

\***Goalbaye, T.,<sup>2</sup>Diallo, M. D.,<sup>1</sup>Madjimbe, G.,<sup>3</sup>Mahamat -Saleh M. and<sup>3</sup>Guisse, A.**

<sup>1</sup>Institut Academic of the Agronomic Sciences and the Environment (IUSAЕ) / University of Sarh,  
BP 105 Sarh, Chad

<sup>2</sup>Section plant Productions and Agronomy, UFR of the Agronomic Sciences, the Aquaculture and the Food Technologies, University Gaston-Shepherd of Saint Louis, BP 234 Saint Louis, Senegal

<sup>3</sup>Department of Plant Biology, Faculty of the Science and Engineering, University Sheik Anta Diop of Dakar, BP 5005 Dakar, Senegal

---

#### ARTICLE INFO

##### **Article History:**

Received 18<sup>th</sup> October, 2016

Received in revised form

22<sup>nd</sup> November, 2016

Accepted 19<sup>th</sup> December, 2016

Published online 30<sup>th</sup> January, 2017

---

##### **Key Words:**

*Zea mays L.*,  
Local varieties,  
Codification,  
Characterization, Chad

---

#### ABSTRACT

In Chad, the food security constitutes a problem insofar where the agricultural production cannot satisfy the demand. The main causes of this decline are often imputed to the climate whose the worsening remains certain, but also the no availability of resources genetic of the major cereals crops. Thus, some local varieties of corn are in the way of extinction because the producers cultivate the local and exotic varieties side by side, or they exchange their seeds and caused the loss of their genetic identity. The objective of the study is firstly, to collect and codify some local varieties of corn of Chad and secondly, to characterize them *in situ* in order to dispose the genetic resources. Ten local varieties have been harvested Ikad1, IKan2, IKan3, IKou4, IKan5, IKad6, BKan7, BKan8, DNga9 and DNga10 have been codified according to their localization and their ethnographic reference mark. They have been characterized from a classification based on their morphology, the environment in which they pushed and the cycle of culture. The different groups have been distinguished in relation to the length of the panicle, to the number of row per cob, to the number of grains by row and to the weight of grains who translate the genetic variability of these local varieties of corn. These local varieties of corn could be to the basis of a program of improvements of corn in Chad.

Copyright©2017, Goalbaye et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

---

#### INTRODUCTION

The cereals constitute the basis of the human food in Chad. In terms of acreage and production, the corn occupies the fourth rank after the millet, the sorghum and the rice. However, it comes in head with 41% in the provision of cereals of the city of Ndjamena before the sorghum, the millet and the rice and in the consumption (Djondang, 2002). It is used for human food and animal feed (poultry, pigs, cattle) and as a raw material in some industries (brewing, soap and oil mill) (Seignobos, 2005). The corn, thanks to the substantial institutional supports of the Chadian government, it is passed of family consumption culture to the culture of market. The increasing integration of its grains in eating habits has created a remarkable increase of the surFigures and the volumes of production.

---

\*Corresponding author: Goalbaye, T.

Institut Academic of the Agronomic Sciences and the environment (IUSAЕ) / University of Sarh, BP 105 Sarh, Chad.

The rate of evolution of the production superior has 300% in the 15 years have been recorded from one region to another. The production of this cereal is passed from 70 000 tons in the years 1998 to 107 000 tons in 2005 (Mbayhoude, 2002). However, this is a production supported by the family farming, still is devoted most to the production for the self-consumption of regions and to the eating habits (Muller, 2004). In Chad most local varieties of corn are in the way of disappearance by the contamination of pollen flow of exotic varieties or the genetic erosion (Goalbaye et al., 2013). Often the producers cultivate local and exotic varieties side by side, or they exchange their seeds and have for consequence the loss of genetic identity. Similar findings were reported by Bellon and Brush (1994). Unfortunately very few works have been made to preserve the local genetic resources of maize (Goalbaye et al., 2014). The existing local varieties are cultivated again in the regions where the corn was a traditional culture during centuries Brush (1995). However, they have not been codified and not characterized. So the objective of the survey is to

codify and to characterize the local varieties of corn of Chad in order to facilitate their distinction. The sampling of local varieties of corn (Kouamé *et al.*, 2010) is conduct in the regions of the country, after the prospecting permitted to harvest the panicles and the whole plants of several genetic resources of corn. So, the local varieties have been codified according to their localization and their ethnographic landmark.

## MATERIALS AND METHODS

### Material of land

Equipment used includes: a GPS (Global Position System) for permitting to take the coordinates of sites and transects; a digital camera for taking the photos of the plants at different development, of the lines, ribbon-meter, a can of paint and a brush permitting the measures and to delimit the parcels, of the bags made of jute to take the samples of corn.

### Methods

#### Prospecting

The prospecting mission made a trip in the canton Danamadji 54 km south of Sarh. In this locality, cornfields were visited mainly in the villages of Kira and Monbolo (altitude 367 m, Latitude 8 ° 88539 and 40605 Longitude 18 °) where soils are the type ferrallitic. Identified local varieties are called guodjidò Kobe (local varieties Ngama). Another mission of exploration conducted by a team of IUSAЕ the researchers Teachers stayed at Isseirom (altitude of 285 m of 13.47104° Latitude and Longitude 15.01615°) and at Bol (altitude 277 m, Latitude of 13.45887° and Longitude 14.71260 °), two cantons of the region of the Chad lake, situated respectively to 320 km and 400 km in the north of Ndjamena. During these displacements one localized with a GPS (global position system) the zones of corn cultures have been prospected. The prospecting has for objective to visit the cornfields to the vegetative stage in order to identify the best plants for harvesting the genetic resources at the time of maturity.

#### Sampling

The second mission surrendered to Isseirom, Bol and to Danamadji to make the sampling. The sampling of the local varieties of corn has been done along a transect South- North and West-East transect through the zones of culture of corn. This is to harvest the local varieties that exist and that are threatened of disappearance. The sampling constitutes one of the stages of recurrent selection diagram described by Morno-Gonzalez and Cubero (1993). It is a mass selection that consists in choosing in the identified fields, the varieties populations of corn presenting the interesting agronomic characters. One first specifies the prospecting number, indeed the appropriate samples carry all one number, the goal of the numbering is to recover the source of the plant material and to know the type of material collected, then one gives the systematic place of the species (family, kind, species, vernacular name) and the type of forwardness defined by the peasants. One also specifies the geographical coordinates of appropriate (GPS) and the conditions of appropriate (attics or fields). One also specifies the approximate size of the share from which the sample has been appropriated. One gives finally the approximate measurements of the sample and the

particular features so possible. The choice of varieties is done on the basis of the differences essentially carrying on the morphological characters: size and/or length of the ear, height of the plant and the cycle of culture describes by the peasants and the yield components. The samples are ears collected in the polders and in parcels of ten of hectares. In the villages of the Bol cantons, Isseirom and Danamadji, several local varieties have been identified, of which some carry the name of the locality where they are cultivated, others carry the name of the population that cultivates them on the contrary. Thus, we identified the varieties matafo1, matafo2 of the Matafo locality and the Kouri varieties of the Kouri population.

### Codification and characterization

These local varieties have been codified according to their localization and their ethnographic reference mark. The varieties have been codified by four letters and by one or two numbers according to the cases. The first letter indicates the initial of source place, the three following letters specify the ethnographic reference mark and the number indicates the prospecting number.

Thus, we have: I = Isseirom, B = Bol, D = Danamadji that is the places of source of these local varieties and: Kad = Kadjidi, Kan = Kanembou, Kou = Kouri, Nga = Ngama that is ethnographic reference marks. On the other hand, the output of grain of all varieties varies from the simple to the double 0, 9 to 1, 8  $\text{tha}^{-1}$  according to the peasants. The description of the local varieties of corn is made from a classification based on the morphology of the plants, the grains, the color, the texture, the environment in which they pushed and the cycles of culture.

### Statistical analysis

Data have been analyzed with the software SPSS (Statistical Package heart Social Sciences, version 16.0). The averages of the different parameters separated by the test of multiple arrangement of Student - Newman - Keuls (SNK).

## RESULTS

### Codification

Ten (10) local maize varieties were collected and codified according to their localization and their ethnographic reference mark (Table 1). These are IKad1, IKan2, IKan3, IKou4, IKan5, IKad6, BKan7, BKan8, DNga9 and DNga10. According to the information received of the peasants of the two cantons Isseirom and Bol, all the selected varieties are hasty, their cycle is about 90 days. Those of Danamadji are semi-belated of about 105 days according to the peasants. All local varieties identified belong to the indurata subspecies. The local varieties of Danamadji have grains of white color. The varieties matafo 1 and matafo 2 of Bol, as well as these who are detained by the Kouri and the Kadjidi of the Asalam village of Isseirom have the grains of white color. On the other hand, the varieties of Douba Isseirom have the grains of yellow color.

### Characterization of the local varieties harvested

The variety BKan7 has an average size, a cycle of culture of 90 days, a long ear of  $13.85 \pm 0.7826$  cm, is composed of

$15.60 \pm 0.8944$  rows of grain and  $23.60 \pm 0, 5477$  of kernels per row, of  $0.202 \pm 0.0027$  kg of weight of 1000 grains (Figure 1). Its grains are globular and medium sized, of white color and bent aspect and vitreous texture. The Variety BKan8 is large size, his cycle of culture is of 100 days. His long ear of  $15.85 \pm 0.6020$  cm, is composed of  $16.40 \pm 0.8944$  of rows of grain and  $29.40 \pm 0.8944$  grains per row, of  $0.198 \pm 0.0021$  kg of weight of 1000 grains.

**Table 1. Local varieties of corn harvested landraces provenance ethnographic mark**

local varieties	localization	Ethnographic reference mark
IKad1	Isseiom	Kadjidi
IKan2	Isseiom	Kanembou
IKan3	Isseiom	Kanembou
IKou4	Isseiom	Kouri
IKan5	Isseiom	Kanembou
IKad6	Isseiom	Kadjidi
BKan7	Bol	Kanembou
BKan8	Bol	Kanembou
DNGa9	Danamadj	Ngama
DNGa10	Danamadj	Ngama

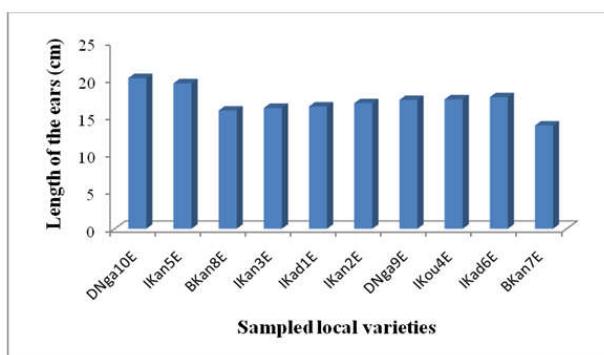
The grains are round and medium sized, of white color and bent aspect and vitreous texture. All two have been harvested in the Sahel zone of Chad, to an altitude of 277m, latitude of  $13.45887^\circ$  and a longitude  $14.71260^\circ$ . The IKad6 variety is of large size, its cycle of culture is of 100 days. The long ear of  $17.65 \pm 0.6020$  cm, is composed of  $13.60 \pm 0.8944$  of rows of the grains and  $29.20 \pm 0.8366$  of grains by row, of  $0.208 \pm 0.0024$  kg of weight of 1000 grains.

and medium-sized, of white color and bent aspect and vitreous texture. It has been harvested in the sahel zone of Chad, to an Altitude of 285 m, a Latitude of  $13.47104^\circ$  and a Longitude of  $15.01615^\circ$ . The IKan3 variety is of large size, his cycle of culture is of 100 days. The long ear of  $16.20 \pm 0.9082$  cm, is composed of  $14.00 \pm 1.4142$  of rows of the grains and  $29.60 \pm 0.844$  of grains by row, of  $0.211 \pm 0.0017$  kg of weight of 1000 grains. The grains are globular and medium-sized, of white color and smooth aspect and vitreous texture. The IKan5 variety is of large size, his cycle of culture is of 100 days. The long ear of  $19.50 \pm 0.7905$  cm, is composed of  $16.40 \pm 0.8944$  of rows of the grains and  $33.80 \pm 0.4472$  of grains by row, of  $0.201 \pm 0.001$  kg of weight of 1000 grains (Figure 2). The grains are globular and medium-sized, of white color and toothed aspect and vitreous texture. The Ikan2 variety is of large size, his cycle of culture is of 100 days. The long ear of  $16.83 \pm 0.5403$  cm, is composed of  $16.40 \pm 0.8944$  of rows of the grains and  $21.40 \pm 0.5477$  of grains by row, of  $0.207 \pm 0.0067$  kg of weight of 1000 grains. The grains are round and medium-sized, of white color and bent aspect and vitreous texture. The IKan3 varieties, Ikan2 and IKan5 have been harvested in the sahel zone, to an Altitude of 269 m, a Latitude of  $13.45801^\circ$  and a Longitude of  $14.98411^\circ$ . The DNGa10 variety is of large size, his cycle of culture is of 105 days. The long ear of  $20.20 \pm 0.8366$  cm, is composed of  $16.40 \pm 0.8944$  of rows of the grains and  $25.60 \pm 2.2803$  of grains by row, of  $0.209 \pm 0.0043$  kg of weight of 1000 grains (Table 2). The grains are globular and medium-sized, of white color and bent aspect and vitreous texture. The DNGa9 variety is of large size, his cycle of culture is of 105 days.

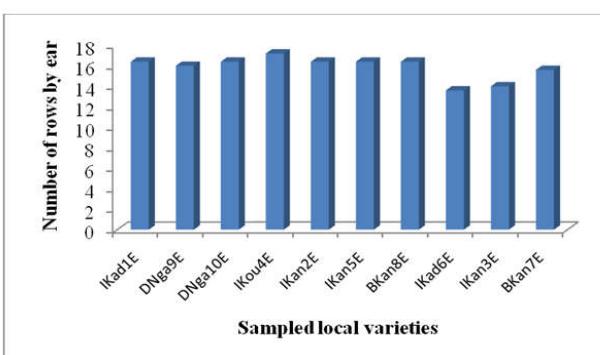
**Table 2. Averages and standard deviations of the securities of the agronomic parameters measured on the sampled local varieties**

Varieties	Length of the ears (cm)	Number of row by ear	Number of grains by rox row	Weight 1000 grains (kg)
Ikan3E	$16.2 \pm 0.9082$ c	$14 \pm 1.4142$ c	$29.6 \pm 0.844$ c	$0.211 \pm 0.0017$ b
Ikad1E	$16.4 \pm 0.9617$ c	$16.4 \pm 0.8944$ a	$31.2 \pm 1.0954$ b	$0.202 \pm 0.0026$ c
DNGa9E	$17.27 \pm 0.6815$ b	$16 \pm 1.4142$ a	$26.2 \pm 0.8366$ d	$0.21 \pm 0.0095$ b
DNGa10E	$20.2 \pm 0.8366$ a	$16.4 \pm 0.8944$ a	$25.6 \pm 2.2803$ d	$0.209 \pm 0.0043$ b
Ikou4E	$17.35 \pm 1.2196$ b	$17.2 \pm 1.0954$ a	$24.6 \pm 0.8944$ de	$0.225 \pm 0.0035$ a
Ikad6E	$17.65 \pm 0.6020$ b	$13.6 \pm 0.8944$ c	$29.2 \pm 0.8366$ c	$0.208 \pm 0.0024$ b
Ikan5E	$19.5 \pm 0.7905$ a	$16.4 \pm 0.8944$ a	$33.8 \pm 0.4472$ a	$0.201 \pm 0.001$ c
Bkan7E	$13.85 \pm 0.7826$ d	$15.6 \pm 0.8944$ b	$23.6 \pm 0.5477$ de	$0.202 \pm 0.0027$ c
Bkan8E	$15.85 \pm 0.6020$ c	$16.4 \pm 0.8944$ a	$29.4 \pm 0.8944$ c	$0.198 \pm 0.0021$ c
Ikan2E	$16.83 \pm 0.5403$ c	$16.4 \pm 0.8944$ a	$21.4 \pm 0.5477$ f	$0.207 \pm 0.0067$ b

Values in the same column followed of a same letter are not meaningfully different to the doorstep of 5% according to the test of Student Newman and Keuls.



**Figure 1. Length of the ears of the local varieties of corn**



**Figure 2. Number of rows by ear of the local varieties of corn**

The grains are globular and medium-sized, of white color and smooth aspect and vitreous texture. The Ikad1 variety is of large size, his cycle of culture is of 100 days. The long ear of  $16.40 \pm 0.9617$  cm, is composed of  $16.40 \pm 0.8944$  of rows of the grains and  $31.20 \pm 1.0954$  of grains by row, of  $0.202 \pm 0.0026$  kg of weight of 1000 grains. The grains are globular

and medium-sized, of white color and bent aspect and vitreous texture. It has been harvested in the sahel zone of Chad, to an Altitude of 285 m, a Latitude of  $13.47104^\circ$  and a Longitude of  $15.01615^\circ$ . The Ikan3 variety is of large size, his cycle of culture is of 100 days. The long ear of  $16.20 \pm 0.9082$  cm, is composed of  $14.00 \pm 1.4142$  of rows of the grains and  $29.60 \pm 0.844$  of grains by row, of  $0.211 \pm 0.0017$  kg of weight of 1000 grains. The grains are globular and medium-sized, of white color and toothed aspect and vitreous texture. The Ikan2 variety is of large size, his cycle of culture is of 100 days. The long ear of  $16.83 \pm 0.5403$  cm, is composed of  $16.40 \pm 0.8944$  of rows of the grains and  $21.40 \pm 0.5477$  of grains by row, of  $0.207 \pm 0.0067$  kg of weight of 1000 grains. The grains are round and medium-sized, of white color and bent aspect and vitreous texture. The Ikan3 varieties, Ikan2 and Ikan5 have been harvested in the sahel zone, to an Altitude of 269 m, a Latitude of  $13.45801^\circ$  and a Longitude of  $14.98411^\circ$ . The DNGa10 variety is of large size, his cycle of culture is of 105 days. The long ear of  $20.20 \pm 0.8366$  cm, is composed of  $16.40 \pm 0.8944$  of rows of the grains and  $25.60 \pm 2.2803$  of grains by row, of  $0.209 \pm 0.0043$  kg of weight of 1000 grains (Table 2). The grains are globular and medium-sized, of white color and bent aspect and vitreous texture. The DNGa9 variety is of large size, his cycle of culture is of 105 days.

8°88539 and a Longitude of 18°40605. The Ikou4 variety is of large size, his cycle of culture is of 100 days. The long ear of  $17,35 \pm 1,2196$  cm, is composed of  $17,20 \pm 1,0954$  of rows of the grains and  $24,60 \pm 0,8944$  of grains by row, of  $0,225 \pm 0,0035$  kg of weight of 1000 grains (Table 2). The grains are round and medium-sized, of yellow color and bent aspect and colorful texture. it has been sampled in the sahel zone, to an Altitude of 285 m, a Latitude of  $13.44533^\circ$  and a Longitude of  $14.98600^\circ$ . In relation to the length of the ears, four groups (a, b, c, d) of local varieties distinguish themselves (Figure 1). The difference of the averages with regard to the length of the ears of the local varieties constituting these groups is meaningful to the doorstep of 5% ( $F = 23,222$ ;  $p = 0,001$ ). In relation to the number of rows by ear, three groups (a, b, c) of local varieties are distinguished themselves (Figure 2), the difference of average of the numbers of rows by ear is meaningful to the doorstep of 5% ( $F = 5, 88$ ;  $P = 0,001$ ).

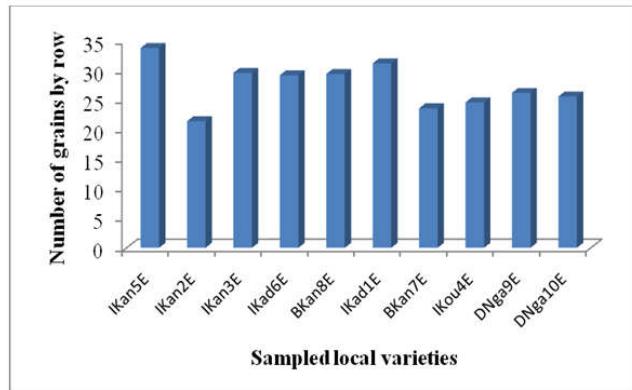


Figure 3. Number of grains by row of the local varieties of corn

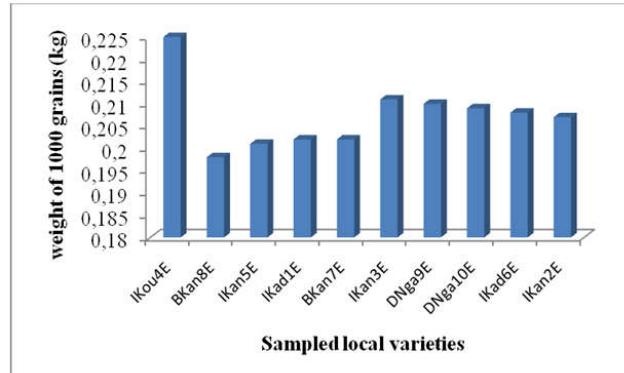


Figure 4. Middleweight of 1000 grains of the local varieties of corn

In relation to the number of grains by row, six groups (a, b, c, d, e, f) of local varieties are distinguished themselves (Figure 3). The difference of the averages with regard to the number of grains by row of these groups is meaningful to the doorstep of 5% ( $F = 106, 53$ ;  $P = 0,001$ ). In relation to the weight of 1000 grains, three groups (a, b, c) of local varieties are distinguished themselves (Figure 4) meaningfully to the doorstep of 5% ( $F = 14,411$ ;  $P = 0,001$ ).

## DISCUSSION

The local varieties of corn are cultivated again today, in particular in the localities of Bol, Isseirom and Danamadjie in Chad where the corn is a traditional culture during the centuries. These results rejoin the findings of the works led by Brush (1995) on the need to maintain genetic biodiversity

through the traditional culture. Some similar studies have also been signalled for the cassava (Koumbo et al., 2012; Kosh-Komba et al., 2014; Agre et al., 2015). So, one is conscious of the necessity more and more to maintain in situ the local varieties where they can evolve (evolutionary conservation) in the conditions of stress in answer to the needs of the agriculturists (Worede, 1993; Brush, 1995). Indeed, these local varieties of corn are important genetic sources for the local adaptation, the economic stability and the durability of the results for the agriculturist. Several authors as Paliwal and Sprague (1981); Paterniani (1985, 1990); Pandey and Gardner (1992); Dowswell et al., (1996) have sustained the thesis according to which the genetic resources should continue to develop and to be used more and more in the programs of improvements of corn tropical. The different groups are distinguished in relation to the length of the ears, to the number of row by ear, to the number of grains by row and to the weight of grains (Attiey, 1991) who translate the genetic variability of these local varieties of corn. The variability between the varieties of corn observed would also be owed to the genetic characters of every variety and to the conditions pedological and climatic different of sampling zones. These results agree with the findings of the similar works of the authors as (Tardieu and Manichon., 1987; Tollenaar., 1977). The corn presents an enormous variability with regard to the color, the texture, the composition and the appearance of the grain. Thus, the described grains are characteristic of tropical bent corn. This description rejoins the one of Esau (1977), Hanway and Ritchie (1987) and Ritchie and Hanway (1992) is based solely on the parts of the grain. Also, the results rejoin the findings of the works of Dowswell et al., 1996, Hallauer (1994). These authors described the types different of corn from a classification based on the morphology (Sanou, 1996) or the constitution of the grain, the color of the grain and the environment in which they are pushed and the cycle of culture.

## Conclusion

The sampling permitted to have genetic resources of maize threatened of disappearance. Indeed, ten (10) local maize varieties: IKad1, IKan2, IKan3, IKou4, IKan5, IKad6, BKan7, BKan8, DNga9 and DNga10 were harvested across the country. With these local varieties obtained by the mass selection on the base of phenotypic appearance, performance improvement process of varieties could start. Also according Pandey and Gardner (1992), these local varieties could be to the basis of the general program of corn improvement, in particular in Chad.

## REFERENCES

- Agre, A.P., Kouchade, S., Odjo, T., Dansi, M., Nzobadila, B., Assogba, P., Dansi, T.O., Akoegninau, T.O., Sanni, A. 2015. Diversity and participating assessment of the cassava cultivars (*Manihot Crantz esculenta*) to the Center Benin. *Int. J. Biol. Csi.*, 9(1):388-408. DOI: <http://dx.doi.org/10.4314/ijbcs.v9i1.33>.
- Attiey, K. 1991. Contribution to the assessment of the variety of the traditional cultivars of corn of the center of the Coast of Ivory. In: State of advancement of the Research of the culture production food-producing in Africa Semi-aride (Ed by Menyonga J M, Bezuneh T, Yayock JY, Soumana), 213-223.
- Scientific communication presented to the inter-networks conference of the OUA/CSTR-SAFGRAD on research and the production of the food-producing cultures in the

- regions Semi-arid of Africa Sub-Of the Sahara, Niamey, Niger, 7-14 March 1991.
- Bellon, M.R. and Brush, S.B. 1994. Keepers of maize in Chiapas, Mexico. *Econ. Bot.*, 48: 196-209.
- Brush, S.B. 1995. In situ conservation of landraces in centers of crop diversity. *Crop Sci.*, 35: 346-354.
- Djondand, K. 2002. The cotton culture in the center of the process of development to Chad, dead end or success. In Acts of the symposium of Ndjamen, of the 25 to February 28, 2002, on the Chad theme", forty years of independence, balance and perspective of the governance and the development".
- Dowswell, C.R., Paliwal, R.L. & Cantrell, R.P. 1996. Maize in the third world Boulder, CO, USA, Westview Press.
- Esau, K. 1977. Anatomy of seed plants, 2<sup>nd</sup> ed. New York, NY, USA, J. Wiley & Sons.
- Goalbaye, T. Guisse, A. Ndiaye, M. and Tissou, M. 2013. Increase maize productivity through improved local varieties of Chad. *Int. J. Biol. Chem. Sci.* 7 (5): 2019-2028.
- Goalbaye, T. Guisse, A. S. Said, Ndiaye M. 2014. Obtaining heterotic local maize populations by interbreeding heels in Chad. *Ind. J. Sci. Res. And Tech.* 2(2):45-49
- Hallauer, A.R., ed. 1994. Specialty corns, Boca Raton, F.L, USA, CRC Press.
- Hanway, J.J. & Ritchie, S.W. 1987. Zea mays. In H. Halvey, ed. Handbook of flowering, vol. 4, Boca Raton, FL, USA, CRC Press.
- Kosh-Komba, E., Akpavi, S.; Woegan, Y.A.; Atato, A.; Duval, M.F.; Dourma, M.; Zinga, I.; Yandia, P.; Longue, D.; Semballa, S. 2014. Diversity morphological agro of *Manihot Esculenta* Crantz (Euphorbiaceae) cultivated in three zones climatic Agro in Republic Centrafricaine (RCA). *European Scientific Newspaper*, 10 (3):365-380..
- Kouamé, K.D.; Péné, B.C. and Zouzou, M. 2010. Sifting of promising commercial varieties of sugar cane in the perimeter sugar-bowl of Ferké 2 to the north of the Coast of Ivory. Optimization of the length of Sci selection. *Nature*, 7(1):97-106.
- Kouumbo, G.R.; Dansi, A. ; Loko, L.Y. ; Orkwor, G.C. ; Vodouhe, R. ; Assogba, P. ; Magema, J.M. 2012. Diversity of cassava (*Manihot esculenta* Crantz) cultivars and its management in the department of Bouenza in the Republic of Congo. *Genet. Resour. Crop. Evol.*, 59(8) :1789-1803. DOI : 10.1007/s10722-012-9803-0.
- Mbayhoudel, G. 2002. Organization of the units of artisanal transformation in zone of savannas: Case of the transformation of sorghum in beer local bili-bili in Moundou in Chad. Acts of the symposium, May 27-31, 2002, Garoua, Cameroon.
- Moreno-Gonzalez, J. & Cubero, J.I. 1993. Selection strategies and choice of breeding methods. In M. D. Hayward, N.O. Bosemark & I. Romagosa, eds, plant breeding: Principles and prospects, P. 281-313. London, Chapman & Hall.
- Muller, B. 2004. Food Security and strategies farmers: case of the zone rizicole of Maga. Memory of engineer Agronom, University of Dschang.
- Paliwal, R.L. & Sprague, E.W. 1981. Improving adaptation and yield dependability in maize in the developing world. Mexico, DF, CIMMYT.
- Pandey, S. & Gardner, C.O. 1992. Recurrent selection for population, variety, and hybrid improvement in tropical maize. *Adv. Agron.*, 48: 1-87.
- Paterniani E., 1985. State of maize breeding in tropical areas in South American. In : Brandolini A., Salamini F. Breeding strategies for maize production improvmnt in the tropics, International Expert Consultation on Maize Breeding in the Tropics, Firenze, Italia, 1985. FAO ; Istituto Agronomico per l'oltremare, Relazioni e Monografie Agrarie Subtropicale e tropicale 100 : 329-340.
- Paterniani E., 1990. Maize breeding in the tropics. *Crit. Rev. Plant Sci.*, 9: 125-154.
- Ritchie, S.W. & Hanway, J.J. 1992. How a corn plant develops. Special report N0. 48. Ames, IA, USA, Iowa State University.
- Sanou, 1996. Analysis of the genetic variability of the local cultivars of corn of the savanna zone west African in view of his management and his use. Thesis of doctorate of the school National Superior Agronomic Montpellier (France), 98 pages.
- Seignobos, C. 2005. Food-producing resources and food choices in the basin of the Chad lake. Symposium International Mega-Chad (FRA), Paris: IRD editions, Prodig., pp. 527 - 561.
- Tardieu F., Manichon H., 1987. Structural State, rooting and water food of the corn / II, growth and spatial disposition of the system of the roots. *Agronomy* 7: 201-211.
- Tollenaar M., 1977. Sink-source relationships during the reproductive development in maize. A review. *Maydica* 22: 49-75.
- Woreda, M. 1993. The role of Ethiopian farmers in the conservation and utilization of crop genetic resources. In *International crop science* I, P. 395-399. Madison, WI, USA, Crop Science Society of America.

\*\*\*\*\*