



## Full Length Research Article

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

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#### 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.

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#### 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 Ndjamen 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.

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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 (Mbayhoudel, 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 conducted 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 ferralitic. Identified local varieties are called guodjidô Kobe (local varieties Ngama). Another mission of exploration conducted by a team of IUSAE 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 Ndjamen. 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 tha<sup>-1</sup> 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 ± 0.7826 cm, is composed of

15.60 ± 0.8944 rows of grain and 23.60 ± 0, 5477 of kernels per row, of 0.202 ± 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 ± 0.6020 cm, is composed of 16.40 ± 0.8944 of rows of grain and 29.40 ± 0.8944 grains per row, of 0.198 ± 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	Isseirom	Kadjidi
IKan2	Isseirom	Kanembou
IKan3	Isseirom	Kanembou
IKou4	Isseirom	Kouri
IKan5	Isseirom	Kanembou
IKad6	Isseirom	Kadjidi
BKan7	Bol	Kanembou
BKan8	Bol	Kanembou
DNga9	Danamadji	Ngama
DNga10	Danamadji	Ngama

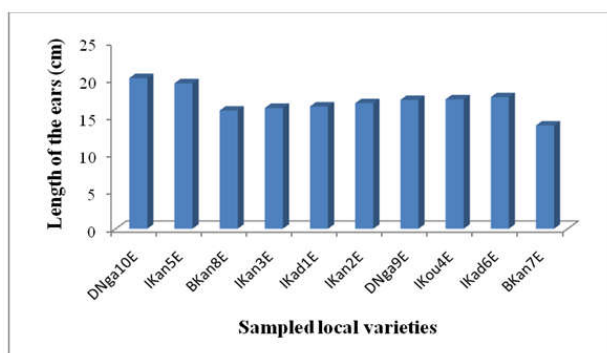
The grains are round and medium sized, of white color and bent aspect and vitreous texture. All two have been harvested in the Sahel zone of Chad, to an altitude of 277m, latitude of 13.45887° and a longitude 14.71260°. The IKad6 variety is of large size, its cycle of culture is of 100 days. The long ear of 17.65 ± 0,6020 cm, is composed of 13,60 ± 0,8944 of rows of the grains and 29,20 ± 0,8366 of grains by row, of 0,208 ± 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° and a Longitude of 15.01615°. The IKan3 variety is of large size, his cycle of culture is of 100 days. The long ear of 16,20 ± 0,9082 cm, is composed of 14,00 ± 1,4142 of rows of the grains and 29,60 ± 0,844 of grains by row, of 0,211 ± 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 ± 0,7905 cm, is composed of 16,40 ± 0,8944 of rows of the grains and 33,80 ± 0,4472 of grains by row, of 0,201 ± 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 ± 0,5403 cm, is composed of 16,40 ± 0,8944 of rows of the grains and 21,40 ± 0,5477 of grains by row, of 0,207 ± 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° and a Longitude of 14.98411°. The DNga10 variety is of large size, his cycle of culture is of 105 days. The long ear of 20,20 ± 0,8366 cm, is composed of 16,40 ± 0,8944 of rows of the grains and 25,60 ± 2,2803 of grains by row, of 0,209 ± 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.

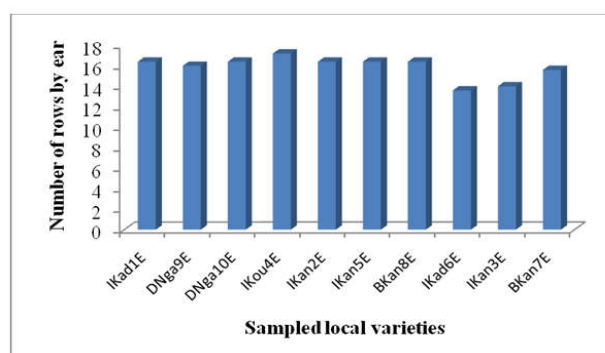
**Table 2. Averages and standard deviations of the securities of the agronomic parameters measured on the sampled local varieties**

Vari varieties	Length of the ears (cm)	Number of row by ear	Number of grains by rox row	Weight 1000 grains (kg)
Ikan3E	16,2 ± 0,9082 c	14 ± 1,4142 c	29,6 ± 0,844 c	0,211 ± 0,0017 b
Ikad1E	16,4 ± 0,9617 c	16,4 ± 0,8944 a	31,2 ± 1,0954 b	0,202 ± 0,0026 c
DNga9E	17,27 ± 0,6815 b	16 ± 1,4142 a	26,2 ± 0,8366 d	0,21 ± 0,0095 b
DNga10E	20,2 ± 0,8366 a	16,4 ± 0,8944 a	25,6 ± 2,2803 d	0,209 ± 0,0043 b
Ikou4E	17,35 ± 1,2196 b	17,2 ± 1,0954 a	24,6 ± 0,8944 de	0,225 ± 0,0035 a
Ikad6E	17,65 ± 0,6020 b	13,6 ± 0,8944 c	29,2 ± 0,8366 c	0,208 ± 0,0024 b
Ikan5E	19,5 ± 0,7905 a	16,4 ± 0,8944 a	33,8 ± 0,4472 a	0,201 ± 0,001 c
Bkan7E	13,85 ± 0,7826 d	15,6 ± 0,8944 b	23,6 ± 0,5477 de	0,202 ± 0,0027 c
Bkan8E	15,85 ± 0,6020 c	16,4 ± 0,8944 a	29,4 ± 0,8944 c	0,198 ± 0,0021 c
Ikan2E	16,83 ± 0,5403 c	16,4 ± 0,8944 a	21,4 ± 0,5477 f	0,207 ± 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 ± 0,9617 cm, is composed of 16,40 ± 0,8944 of rows of the grains and 31,20 ± 1,0954 of grains by row, of 0,202 ± 0,0026 kg of weight of 1000 grains. The grains are globular

The long ear of 17,27 ± 0,6815 cm, is composed of 16,00 ± 1,4142 of rows of the grains and 26,20 ± 0,8366 of grains by row, of 0,21 ± 0,0095 kg of weight of 1000 grains. The grains are round and large, of white color and bent aspect and mealy texture. The DNga10 varieties and DNga9 were sampled in the sudanea zone in Chad, to an Altitude of 367 m, a Latitude of

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% ( $F = 5, 88$ ;  $P = 0,001$ ).

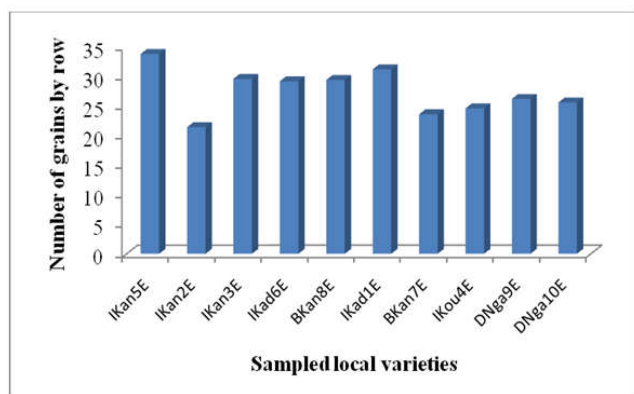


Figure 3. Number of grains by row of the local varieties of corn

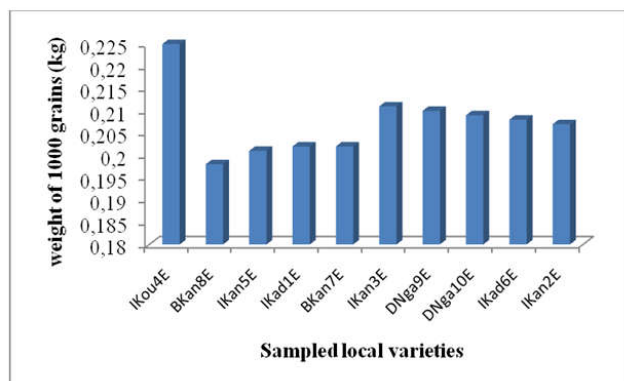


Figure 4. Middleweight of 1000 grains of the local varieties of corn

In relation to the number of grains by row, six groups (a, b, c, d, de, 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 Danamadji 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.

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