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# ETHNOBOTANICAL AND AGROMORPHOLOGICAL CHARACTERIZATIONS OF *Corchorus olitorius* L. ACCESSIONS IN BURKINA FASO

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**ABSTRACT**

*Corchorus olitorius* is an indigenous leafy vegetable which is widely consumed in Africa and Asia. In order to investigate agronomic practices, agromorphologic diversity and ethanobotanic knowledge of producer, present study has been carried out in the four agro-climatic zones of Burkina Faso. During this study, total 178 accessions were collected, among these 111 accessions were characterized on the basis of 17 well identified qualitative (5) and quantitative (12) characteristics. Results of study revealed that most of the identification characteristics and terminology used for identification of *C. olitorius* is based on the visible phenotypic characteristics. Two most common morphotypes which was identified during the study was "*bulvank yanga*" and "*bulvank moaga* or *bulvank raogo*". All the identified 111 accessions were divided in four groups. Among these groups 1 have eighteen accessions (18) which were characterized by poor performing and late growing individuals with weak stem and leaves outputs. While groups 2 and 3 are represented by 33 and 42 accessions respectively these were characterized by individuals with average performance. Group 4 is made up of eighteen (18) accessions, characterized by individuals with cycle precocious semi-flowering and very high morphological performances (PEL, FWL, FWS and DIS). Most of the ethamobotanic knowledge is based on the traditional and phenotypical knowledge which they gained from their ancestors..

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## 1 INTRODUCTION

*Corchorus olitoris* is an annual herbaceous plants which belongs to family Thiliacée. Actual information regarding the origin of this species is not available but most of the researcher's believed that it is originated in Asia and Africa (Kundu et al., 2012). Due to its high nutritious values and socio-economic interest, it is widely cultivated in these two continents (Mbaye et al., 2001). Mostly its leafy part used as vegetable but some time stem of *C. olitorius* also used in making ocal beer "dolo" (Kiébré, 2016). Further, medicinal value of *C. olitorius* in Burkina Faso was also reported by Olivier-Beever, (1986) and Millogo - Rasolodimby (2001). In Burkina Faso, *C. olitorius* is widely grown in the sub urban areas where a mass selection is plasticized according to the preferential characters of the consumers.

Within the framework of the conservation and popularization of the plant, the works of Kiébre (2016) have shown the existence of agromorphologic diversity within forty one accessions. Although many activities were carried out to protect *C. olitorius* diversity but their mode of management is still unknown and very few information is available regarding the collection, characterization and conservation of this vegetable. Therefore, in order to collect information on the management of the pot corète and to determine its agromorphologic diversity in various agroclimatic zones of Burkina Faso, this ethnobotanic investigation has been carried out follow-up of an accessions collection.

## 2 MATERIELS AND METHODS

### 2.1 Ethnobotanic investigation and prospection collection

A prospection collection of *C. olitorius* accessions and ethnobotanic investigation were carried out from 2012 to 2015 in the 17 provinces of three agroclimatic zones of Burkina Faso. Being a semi-grown plant, random sampling technique described by Marchenay & Lagarde (1986) was used for the collection of accession and ethanobotanic investigation. Seeds of various accessions were collected from the producers, nature and markets. Each collected accession was preserved in an envelope until the setting in seedbed. During the collection, surveys were conducted with the producers through semi-structured questionnaire to collect information regarding the origin, number, names of the cultivars, growing methods, preferential morphological characters, mode of seeds obtaining, growing period, methods of conservation as well as the various uses.

### 2.2 Agro-morphological characterization of the collected accessions

#### 2.2.1 Plant material

Plant material consist 111 accessions, which was selected from the collection of 178 accessions. This selection was based on the germination quality and the quantity of the obtained seeds.

#### 2.2.2 Site and experimental design

The study was carried out in June 2015 at the experimental station of Gampela Rural Institute of Development located at 1°21 Western longitude and 12°24 of Northern latitude (Burkina Faso). To remove the dormancy, the grains were soaked in hot water for 5 to 10 seconds. The setting in seedbed took place on 20th June 2015 and the pricking out one month later on a silt-sandy soil. The experimental design is RCBD with three repetitions. The replications were separated by an alley of 2 m. In a replication, each accession was planted out on a line of 4.5 m with a spacing of 0.6 m between the lines and 0.5 m between the seed holes. Organic manure @ 200Kg/ha and NPK fertilizers @ 200Kg/ha was applied at the time of ploughing and two weeks after the pricking out.

### 2.3 Studied characters

Total seventeen (17) characters were chosen for the characterization of *C. olitorius* accessions, among these five (5) were qualitative and rest 12 were quantitative. The qualitative characters concerned with the fresh fruit color (FFC); stem color (STC); stipule color (SCO), leaf from (LEF) and leaf color (LEC). While measured quantitative characters were divided in three major groups: (i) Characters related to the size (ii) characters related to the leaves and (iii) flowering day cycle. In size related characteristics, plant height (PLH); diameter of stem (DIS); number of primary ramifications (NPR) and the fresh weight of stem (FWS) were studied while in case of leaves characteristics length of petiole (PEL) and limb (LIL) along with the width of leaves limb (LIW) and the fresh weight of leaves (FWL) were studied. Fruit-related characters concerned the length of the peduncle (PLE) and (FRL) fruit and the width of the fruit (FRW).The flowering days number (FND) was also studied in present study and it were calculated at the time of 50% flowering. Figure 1 showed the measurement technique of some qualitative traits as mentioned by Kiébre (2016).

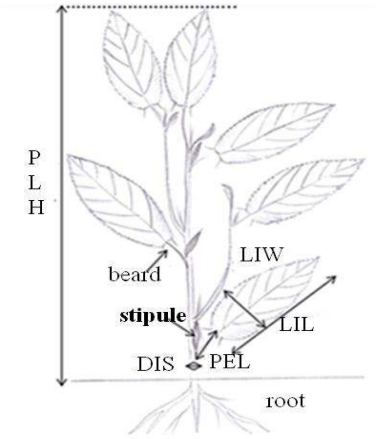



Figure1 Some measurement method of quantitative variables (cm)

### 2.4 Statistical analyses

The Microsoft Excel 2007, Genstat, v4.10.3 (International VSN Ltd, 2011) and XLSTAT pro version 7.1 (htt://www XLSTAT.com/fr) was used to analyze the collected data. Excel was used for calculation of the frequencies and construction of the graphs of the results of the investigation. For the whole studied quantitative characters, Genstat v4.10.3 was used for the variance analysis. XLSTAT was used to study the relations between the studied characters, the structuring of the variability and the characterization of the groups resulting from the CAH.

## 3 RESULTS

### 3.1 Peasant denomination

Survey was conducted in the 17 provinces of the Burkina Faso (Figure 2). As result, 178 accessions were collected. Results of study revealed that *C. olitorius* is exploited by several ethnic groups as leafy-vegetable (Table 1) but its vernacular name varies with the ethnic groups and in total 18 surveyed ethnic groups this vegetable is known by 31 names which were listed in table 1.The number of vernacular names listed by ethnic group varied not only from one ethnic group to another but also inside a same ethnic group. With only one name registered among the *Fulany , Goins, Haoussa, Bobo, Zaoussé, Karaboro, Libi, Pougouli, Robo, Senoufo, Turka, the corète* is indicated by several names in the other ethnic groups.

Table 1 Peasan nomenclature of the corète

| S. N | Ethnic group | Vernacular name of C. olitorius |
|---|---|---|
| 1 | **Bobo** | *Dongonon* |
| 2 | **Bwaba** | *Foirou, foirie, Fouahin, Hountouwi* |
| 3 | **Dafing** | *Sobon, sobo* |
| 4 | **Goin** | *Djampoilé* |
| 5 | **Gourmatché** | *Tihalfali, tipindi* |
| 6 | **Gourounsi** | *Kagnonfoforo, êwôh, kowoo, Wowoa* |
| 7 | **Haoussa** | *Tourgounoua* |
| 8 | **Karaboro** | *Tampala* |
| 9 | **Libi** | *Vonkion* |
| 10 | **Mossi** | *Bulvaka, bulvanka* |
| 11 | **Fulany** | *Fakou* |
| 12 | **Pougouli** | *Waro* |
| 13 | **Robo** | *Dongonon* |
| 14 | **Samo** | *Yérénké, boalôn, bole* |
| 15 | **Senoufo** | *Vôlongô* |
| 16 | **Siamou** | *Koulanan, djoula, winwin* |
| 17 | **Turka** | *Yalga* |
| 18 | **Zaoussé** | *Zilvanka* |

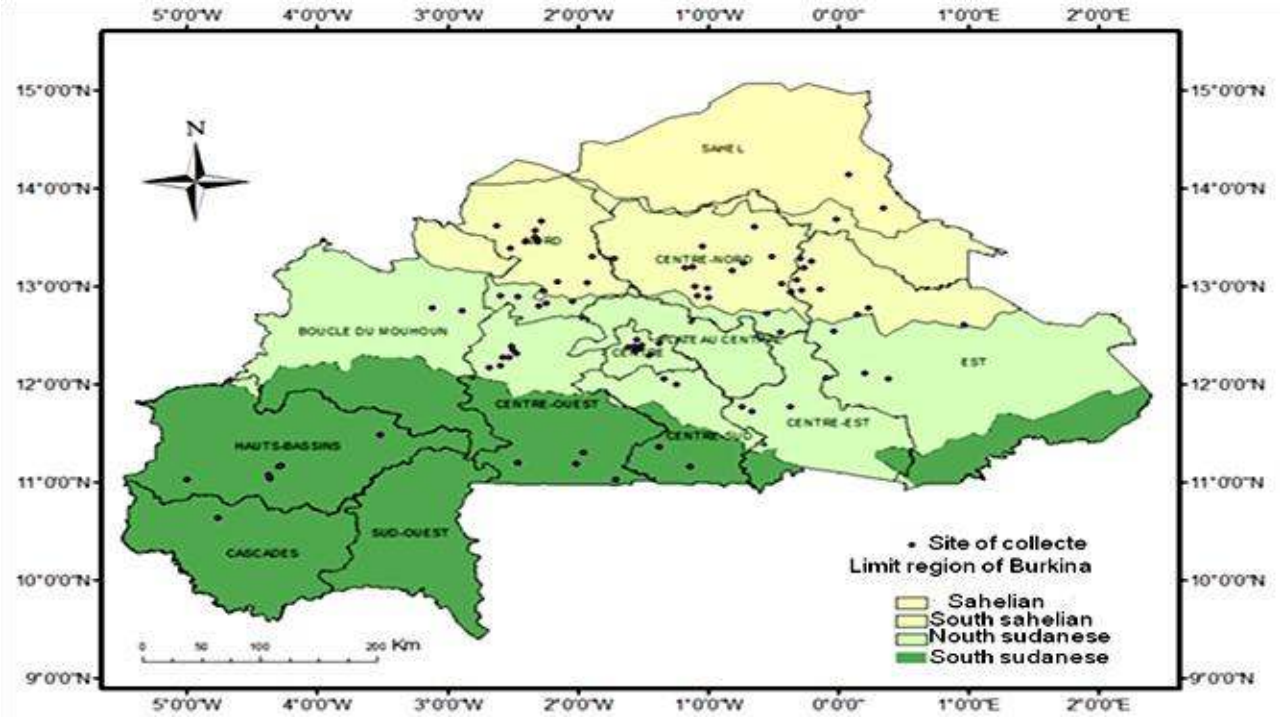
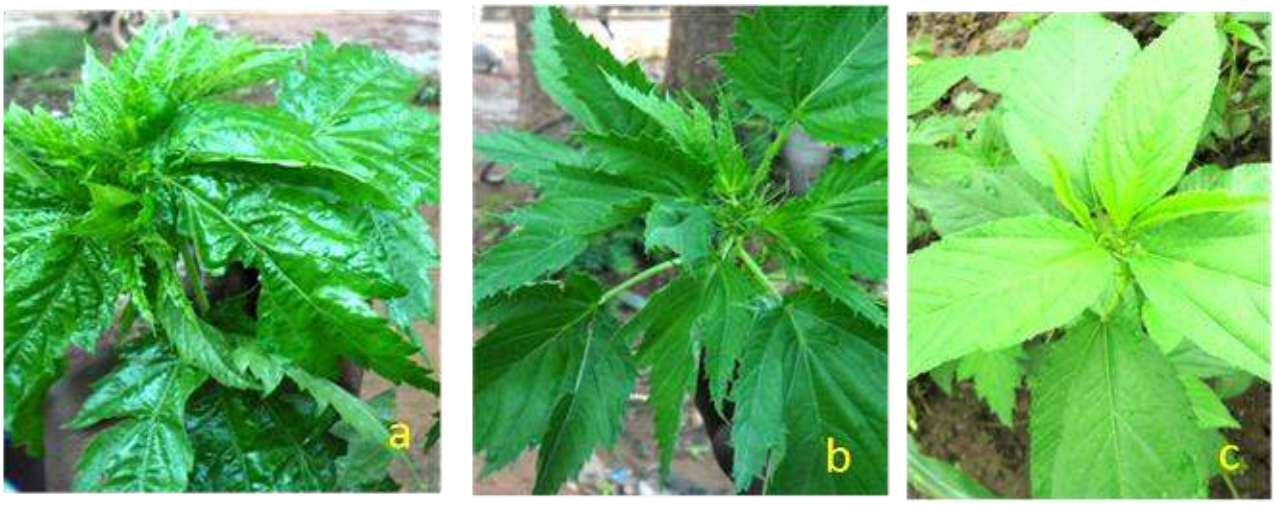



Figure 2 Prospection sites map of *C. olitorus*




**a. Bright green-light leaves** **b. non-bright green dark leaves** **c. oval-lanceol leaves**

Figure 3 Three common morphotypes identified from the Burkina Faso

**3.2 C. olitorius Nomenclature and character of interest**

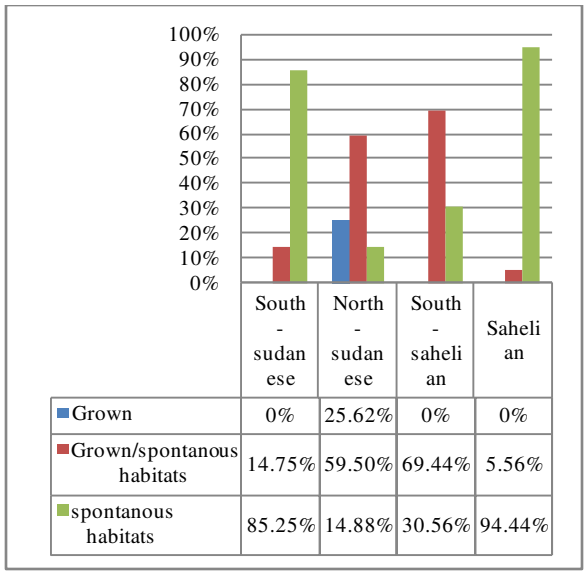
Nomenclature given by various ethnic groups depends on various attributes related to the morphological characters, phenology (cycle), probable source of the first seeds and the statute of the plant (grown or wild). Relying on this denomination, the number of morphotype varied from one to four. Minority (8.36%) of the ethnic group (group 1) identified *C. olitorius* on the basis of use as leafy vegetable; while group 2 identified this vegetable on the basis of stem colors (29.46%) and 4 (1.45%) morphotypes were identified according to the size and laves. However, majority (60.73%) of the surveyed ethnic group identified morphotypes on the basis of the shape and appearance of the leaves (Figure 3). A morphotype with the leaves of oval to oval-lanceol called in mooré "*bulvaka or bulvaka moaga or bulvag raogo*" which means "local Corchorus" "Corchorus male". While the same morphotype is known by "*Yérénké samo*" in samo language which means "*Corchrus samo*" (Figure 3c). According to the consumer's behaviors, this morphotype is characterized by a low content of water and a high rate of mucilage and dry substance. This morphotype would be more preferred in rural area and is still said to be in protoculture. The second morphotype (Figure 3a and 3b) is characterized by triangular leaves with strong indented (Laciniée) and it is known as "bulvank yanga" in mooree ethinic group. Within the "bulvak yanga", the market-gardeners distinguish two sub-morphotypes referring to the aspect of the color of leaves. The morphotype with non-bright green dark leaves (Figure 3b) and the morphotype with bright green-light leaves (Figure 3a) called in mooré "nassar bulvak" which means "corchorius white " referring to the fact that it would be an improved variety or "bulvag pindga" with reference to the brightness of the leaves or "bulvag boutougou" which means expensive seeds *Corchorus*. The same is also known by "Mali bulvaka or Côte.d'ivoire bulvaka" with reference to the possible origin of the first seeds or "*Corchorus baoule* " with reference to the ethnic group which introduced this variety into the locality. For the producers this improved variety has a long cycle and high foliar output.

The morphotype with bright green-light leaves would be the most preferred (95 % of those who have been enquired) in urban area. This variety is unknown for the rural producers. However, the homonymy is met with the local denomination. Thus, the denomination corète 'male' and corète 'female' often brings confusion in certain localities. Indeed, the *C. tridens* called wild corète or non grown is also known under the name of corète male. The same is also called corète for "dolo" because of its stems rich in mucilage generally used for the preparation of local beer "dolo". Further, *C. tridens* is also used as Leafy-vegetable in replacement of C. *olitorius* called corète for "sauce".

**3.3 Statute of the *C. olitorius***

Importance of *C. olitorius* varies from one zone to other and it depending on the ethnic groups. Primarily it collected for the family consumption as a Leafy-vegetable in the various agro-climatic zones of the country. In sub-Saharan zone, 69.44% of the consumers pick leaves of *C. olitorius* from the spontaneous habitats while 30.56% of consumers pick the leaves from the vegetables gardens. In the north- soudanian zone; 59.50% of consumers collected leaves from the natural habitats and 25.62% from the practices the growing (Figure 4). Rest associates (14. 88%) cultivate and harvest it from spontaneous habitats.

With regard to the ethnic groups (Table 2) the practices vary from one ethnic group to another. Indeed, among the studied ethnic group, ethnic group Fulani (93.33%) collect *C. olitorius* laves from the spontaneous habitats while rest of the members (6.67%) of this ethnic group were collect leaves from spontaneous as well as from




| | South - sudanese | North - sudanese | South - sahelian | Sahelian |
|---|---|---|---|---|
| Grown | 0% | 25.62% | 0% | 0% |
| Grown/spontanous habitats | 14.75% | 59.50% | 69.44% | 5.56% |
| spontanous habitats | 85.25% | 14.88% | 30.56% | 94.44% |

Figure 4 the plant distribution state according to the different agro-climatic zones

Table 2 growing of the pot corète according to the ethnic group

| Ethnic group | Grown | Grown + spontaneous habitats | spontaneous habitats | Total of survey |
|---|---|---|---|---|
| ***Bobo*** | - | 50.00% | 50.00% | 22 |
| ***Bwaba*** | - | 66.67% | 33.33% | 24 |
| ***Goin*** | - | - | 100.00% | 12 |
| ***Gourmatché*** | | 68.75% | 31.25% | 16 |
| ***Gourounsi*** | 27.59% | 65.51% | 6.90% | 29 |
| ***Mossi*** | 18.61% | 54.79% | 26.60% | 188 |
| ***Fulani*** | - | 6.67% | 93.33% | 15 |
| ***Samo*** | - | 90.48% | 9.52% | 21 |
| ***Siamou*** | - | - | 100.00% | 11 |
| **Other ethnic groups** | 5.26% | 26.32% | 68.42% | 19 |
| **Total** | - | - | - | 355 |

Table 3 Mode of seeds obtaining among the studied towns

| Town | Donation | Purchase | Selection |
|---|---|---|---|
| **Ouagadougou** | 1.32% | 23.18% | 7.95% |
| **Bobo-Dioulasso** | 1.32% | 9.93% | 10.60% |
| **Other** | 7.3% | 3.31% | 35.05% |
| **Total** | 9.94% | 36.42% | 53.64% |

cultural conditions. On the other hand, in case of Mossi ethnic group 26.60% of this group members collect leaves from the spontaneous habitats while 18.61% from cultural condition and rest 54.79% were collected from both spontaneous and cultural methods.

### 3.4 Mode of Seeds collection and conservation

During study three modes of seeds collection viz. mass scale selection, purchase and donation was identified (Table 3). Among the studied producers, 53.64% of the producers follow mass scale selection practiced but this practice gradually decreased from small town to the big ones and it is practiced only 10.60% by the producers of town Ouagadougou, 7.95% by the Bobo-Dioulasso and 35.09% producers of the other town covered during the investigation. In this method, farmers stored seeds of best plants during the harvesting and these were used for the next year production.

Second method of seed collection, which was common among the surveyed producers is purchase. Among the total studied producers, 36.42% were buy seeds from the market with the tradesmen. In case of studied towns, 23.18% and 9.93% producers of the Ouagadougou and Bobo-Dioulasso purchased seeds from the market respectively. The third mode of seeds obtaining is the donation, 9.94% of the producers practiced this technique of seed collection.

In case of seed preservation techniques, respondents of the studied area used two seeds preservation techniques viz. capsule coating and plastic sheet preservation. Among the studied respondents, minority of the producers (1.5%) preserves their seeds (grains) with the capsules. These capsules are packed in a part of fabric, sachets and hanged at the roofs of the houses. On the other hand, the majority (98.5%) of the respondents preserves their seeds in plastic sachets, bottles and cans. These plastic sachets, bottles and cans are kept in very dry places like in Canaries or in attics (94.9%) or using ash (3.6%).

### 3.5 Farming system in Burkina Faso

In Burkina Faso, the majority of producers (80.44 %) produced *C. olitorius* during both rainy and off season while minority of the producers (17.39%) practice cropping in only rainy season and 2.17% in off-season. The analysis of the growing systems revealed that most of the rural producers produced it as mixed crop with other economically important crops while in case of urban producers it is produced as a monoculture in home gardens. In mixed cropping, corète is usually grown in association with other vegetable species like the amaranth (*Amaranthus sps.*), African cabbages (*Cleome gynandra*), various cabbages (*Brassica sps.*), the sorrel (*Hibiscus sps.*), lettuce (*Lactuca sativa*) and the cereals (corn).


a: Dish of 100 to 300f CFA; b: Dish called yorouba, 300 to 500f CFA; c: Parcel of 5000 to 75000F CFA; d: Heap of 50 to 100FCFA

Figure 5 Selling of *C. olitorius* leaves in Ouagadougou

In gardens, seeds are sown broadcast where the quantity of seeds used per unit area is not really known. Most of the producers used NPK fertilizers for better plant growth and it applied approximately 14 days after sowings. Along with this, on the attack of insect like caterpillars, locusts, most of the producers used insecticides but the types and doses of these insecticides are not predefined.

**3.6 Socio-economic importance of *C. olitorius***

In case of socio-economic importance, most of producer residing in town produced *C. olitorius* in the vegetable gardens for selling fresh or in the form of dry leaves. While in case of rural producers, about 90% production is for auto consumption. Dry leaves of *C. olitorius* are transported from rural areas to the urban centres where they are sold. Various recipients are used for the selling at varying prices from 150 to 500 F CFA (Figure 5). In addition to the leaves, the seeds are also sold in sachets or cans of 0.35, 0.5 and 1 liter. The price of a seed cans vary from 1500 to 6000 F CFA and this is depending on the periods and morphotypes. Thus, the production of the pot corète constitutes a significant source of incomes for the producers in fact for the women who constitute 69% in urban areas and 97.2% in rural areas.

**3.7 Agro-morphological characterization of the collected accessions**

**3.7.1 Variation of the qualitative characters:**

Results related to the qualitative characteristics have been represented in the table 4. Various accessions of *C. olitorius* showed great existence of variability. This variability is higher as compared to the observed by Kiébre (2016). During the survey, total five (5) types of stem colors were observed (Figure 6). The fruits were either of green color with yellow slits (18.7%) or green color with red slits (81.3%). Two morphological types were noted


a: Green stem ; mixed stem with red-lighttige insertions c: mixed stem with red-bright, d : violet stem ; e : red-bright stem

Figure 6: Variation in the stem color of *C. olitorius*

Table 4 Studied five qualitative characters of *C.olitorius* in Burkina Faso for all 111 accessions

| t | Modalities | Frequency (%) |
|---|---|---|
| Stem colour (**STC**) | Red-bright | 53.20 |
| | Violet | 10.21 |
| | mixed: red-bright | 10.5 |
| | mixed: red-light | 9.01 |
| | Variable | 17.08 |
| Leaf Colour (**LEC**) | Brillant Green-light | 4.06 |
| | Brillant green-dark | 4.06 |
| | Green-dark | 32.52 |
| | Green-light | 59.35 |
| Stipules colour (**SCO**) | Red | 81.3 |
| | Green | 18.7 |
| Fresh fruit colour (**FFC**) | Yellow green | 18.7 |
| | Reed green | 81.3 |
| Leaf form (**FFE**) | Lancéolée | 53.66 |
| | Oval | 3.25 |
| | Lancéolée-oval | 22.76 |
| | Triangular | 20.34 |

color with red slits (81.3%). Two morphological types were noted on the basis of the form and margin of the leaves (Figure 6).

Among the total surveyed accessions, majority (79.66%) of the evaluated accessions belongs to *C. olitorius var olitorius* L variety while rest 20.34% accessions belongs to *C. olitorius var incisifolius* Asch. & Schw variety. The leaves of *C. olitorius var olitorius* are of variable form oval (3.25%) to oval-lancéolée (22.76%) or lancéolées (53.66%). On the other hand the leaves of *C. olitorius var. incisifolius* Asch. & Schw. are triangular (20.34%). Further, color aspects of the leaves were also varying with the accessions (Figure 7). The leaves were either of brillant green light color (4.06%); brillant green dark (4.07%); green-dark (32.52%) and green-light (59.35%).

Table 5 Average performance of the 111 accessions of *C. olitorius*

| Variable | Minimum | Maximum | Average | CV % | F Genotype | FBloc |
|---|---|---|---|---|---|---|
| **LEL** | 2.758 | 8.575 | 5.327 | 14.46 | $4.63^{**}$ | $4.54^{*}$ |
| **LIL** | 8.150 | 17.563 | 13.881 | 9.97 | $4.34^{**}$ | $21.40^{**}$ |
| **LIW** | 3.563 | 8.594 | 5.275 | 13.14 | $4.00^{**}$ | $9.00^{**}$ |
| **FND** | 48.000 | 88.000 | 59.785 | 4.75 | $4.64^{**}$ | $2.43^{ns}$ |
| **PLH** | 94.500 | 177.250 | 136.394 | 6.76 | $2.29^{**}$ | $175.91^{**}$ |
| **DIS** | 1.275 | 3.260 | 2.057 | 11.84 | $1.16^{ns}$ | $10.54^{**}$ |
| **PRN** | 6.250 | 39.750 | 14.347 | 23.41 | $2.92^{**}$ | $3.80^{*}$ |
| **FWL** | 83.650 | 712.500 | 215.558 | 34.50 | $0.88^{ns}$ | $4.26^{*}$ |
| **FWS** | 189.830 | 1647.500 | 589.370 | 26.87 | $0.92^{ns}$ | $0.54^{ns}$ |
| **PLE** | 0.288 | 0.575 | 0.428 | 9.54 | $2.04^{**}$ | $21.17^{**}$ |
| **FRL** | 0.538 | 8.338 | 6.454 | 9.24 | $1.73^{**}$ | $0.39^{ns}$ |
| **FRW** | 0.399 | 0.658 | 0.472 | 6.56 | $2.91^{**}$ | $0.06^{ns}$ |

*LOP: Petiole length; LOL: Limbe length; LAL: Limb width; NJF: 50% flowering number days; HPL: Plant height; DTI: Diameter of the stem; NRT: Primary ramification numbers; PFF: Fresh weight of the leaves; PFT: Fresh weight of the stems; LOE: Pedoncule length; LOF: Fruit length; LAF: Fruit width; CV: coefficient of variation; F:value of Fisher; *: Significant difference at 5%, ** : significant difference at 1%, ns: non-significant difference.*

### 3.7.2 Average performances of the accessions

The variance analysis (Table 5) suggests the existence of a significant variability within the collection for the majority of the studied characters. Thus, except for the diameter of the stem, fresh weight of the leaves, weight of the stems and all the other characters significantly discriminate the accessions studied at the threshold of 1%. The matrix of correlation of Pearson (Table 6) revealed many significant correlations at the thresholds of 5% and 1%. Length of the petiole is positively and significantly correlated with the width of the limb (R = 0.785) and the diameter of the stem (0.363). Similarly, height of the plant is also positively correlated with the number of ramifications (R = 0.335) and with the


A: non bright triangular green-dark leaf color


b: green-bright-light triangular leaves


c: non bright green-dark oval-lanceolè leaves

Figure 7 Reported colors and forms of the *C. olitorius* leaves

diameter of the stem (R = 0.382). There is also a positive correlation between the number of primary ramification and the width of the limb (R = 0.499). As for the leaf output, it is positively correlated with the length of the limb (0.319) and with the diameter of the stem (R = 0.257) (Tab]le 7).

### 3.8 Agro-morphological diversity structuring

Agglomerative hierarchical clustering carried out on the weighted averages of the Euclidean distance (Figure 8) revealed a distribution of the 111 accessions in four (4) groups respectively made up of 18, 33, 42 and 18 accessions.

#### 3.8.1 Characterization of the groups resulting from Cluster Analysis

The discriminating factorial analysis (DFA) of the four groups resulting from the HAC showed that the first two axes explain the totality of variability. The first axis explains it to 95.73% and the second up to 3.65%. This analysis made possible to characterize

Table 6: Effect of the botanical variety and the agro-climatic zone on the variation of the characters of the accessions of *C. olitorius*

| Factors | Variety | | | Agro-climatic zone | | | | |
|---|---|---|---|---|---|---|---|---|
| **Characters** | V1 | V2 | F | N-sud | Sah | S-sah | S-sud | F |
| **PEL** | 5 .18$^{a}$ | 6.24$^{b}$ | 24.62$^{**}$ | 5.61$^{b}$ | 5.26$^{a}$ | 5.35$^{a}$ | 5.39$^{b}$ | 18.73$^{**}$ |
| **LIL** | 14.36$^{b}$ | 11.73$^{a}$ | 60.44$^{**}$ | 12.83$^{a}$ | 14.54$^{b}$ | 14.49$^{b}$ | 13.86$^{a}$ | 21.12$^{**}$ |
| **LIW** | 5.1$^{a}$ | 6.22$^{b}$ | 35.8$^{**}$ | 5.61bc | 4.65$^{a}$ | 5.03$^{ab}$ | 5.88$^{c}$ | 10.11$^{**}$ |
| **FND** | 59.79$^{a}$ | 60.55$^{a}$ | 0.82$^{ns}$ | 60.96$^{b}$ | 55.99$^{a}$ | 58.69$^{a}$ | 63.95$^{b}$ | 15.95$^{**}$ |
| **PLH** | 136.4$^{a}$ | 138.4$^{a}$ | 0.62$^{ns}$ | 136.8$^{a}$ | 135.9$^{a}$ | 136.3$^{a}$ | 139.2$^{a}$ | 0.41$^{ns}$ |
| **DIS** | 2.07$^{a}$ | 2.05$^{a}$ | 0.31$^{ns}$ | 2.1$^{a}$ | 2.04$^{a}$ | 2.02$^{a}$ | 2.21$^{b}$ | 6.18$^{**}$ |
| **PRN** | 14.18$^{a}$ | 16.18$^{b}$ | 5.81$^{*}$ | 14.66$^{ab}$ | 12.0$^{a}$ | 13.69$^{a}$ | 19.20$^{c}$ | 15.33$^{**}$ |
| **FWL** | 218$^{a}$ | 200.4$^{a}$ | 2.77$^{ns}$ | 218$^{a}$ | 256.9$^{a}$ | 207.2$^{a}$ | 229.3$^{a}$ | 2.35$^{ns}$ |
| **FWS** | 583.4$^{a}$ | 595.5$^{a}$ | 1.42$^{ns}$ | 579$^{ab}$ | 581.9$^{ab}$ | 592.1$^{b}$ | 574.9$^{a}$ | 18.26$^{**}$ |
| **PLE** | 0.43$^{a}$ | 0.42$^{a}$ | 1.39$^{ns}$ | 0.42$^{a}$ | 0.43$^{a}$ | 0.43$^{a}$ | 0.42$^{a}$ | 0.63$^{ns}$ |
| **FRL** | 6.5$^{b}$ | 6.1$^{a}$ | 7.7$^{**}$ | 6.37$^{a}$ | 6.51$^{b}$ | 6.5$^{b}$ | 6.28$^{a}$ | 3.83$^{*}$ |
| **FRW** | 0.46$^{a}$ | 0.65$^{b}$ | 8.09$^{**}$ | 0.44$^{a}$ | 0.48$^{a}$ | 0.49$^{a}$ | 0.68$^{b}$ | 3.23$^{*}$ |

*N-sud: North-sudanese; Sah: Sahelian; S-sah: S-sahelian; S-sud: South sudanese; PEL: Petiole length; LIL: Limb length; LIW: limb width; FND: 50% Flowering days number; PLH: Plant height; DIS: Diameter of the stem; NRP: Primary ramification numbers; FWL: Fresh weight of the leaves; FWS: Fresh weight of the stems; PLE: Pedoncule length; FRL: fruit length; FRW: fruit width ; CV: variation coefficient; F:value of Fisher; *: significant difference with 5%, **: significant difference with 1%, ns: nonsignificant difference.*

Table 7 Correlation between the quantitative characters of *C. olitorius*

| Variables | PEL | LIL | LIW | FND | PLH | DIS | PRN | FWL | FWS | PLE | FRL | FRW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PEL** | **1** | | | | | | | | | | | |
| **LIL** | -0.504$^{**}$ | | | | | | | | | | | |
| **LIW** | 0.785$^{**}$ | -0.538$^{**}$ | **1** | | | | | | | | | |
| **FND** | 0.719$^{**}$ | -0.249$^{*}$ | 0.463$^{*}$ | **1** | | | | | | | | |
| **PLH** | 0.418$^{*}$ | 0.073 | 0.286 | 0.247$^{*}$ | **1** | | | | | | | |
| **DIS** | 0.363$^{*}$ | 0.107 | 0.213 | 0.393$^{*}$ | 0.382$^{*}$ | **1** | | | | | | |
| **PRN** | 0.669$^{**}$ | -0.175 | 0.499$^{*}$ | 0.748$^{**}$ | 0.335$^{*}$ | 0.367$^{*}$ | **1** | | | | | |
| **FWL** | -0.134* | 0.319$^{*}$ | -0.082 | -0.034 | -0.045 | 0.257$^{*}$ | 0.049 | **1** | | | | |
| **FWS** | -0.196 | 0.272$^{*}$ | -0.158 | -0.230 | 0.115 | 0.415$^{*}$ | -0.103 | 0.215$^{*}$ | **1** | | | |
| **PLE** | -0.115 | 0.210$^{*}$ | -0.154 | -0.080 | -0.048 | 0.062 | -0.198 | 0.052 | -0.026 | **1** | | |
| **FRL** | -0.353$^{*}$ | 0.469$^{*}$ | -0.527$^{**}$ | -0.195 | 0.139 | 0.100 | -0.282$^{*}$ | 0.063 | 0.154 | 0.444$^{*}$ | **1** | |
| **FRW** | 0.096 | -0.056 | 0.098 | 0.078 | 0.034 | 0.097 | 0.035 | 0.095 | -0.045 | 0.184 | 0.048 | **1** |

** : significant correlation to the threshold of 5%, **: significant correlation to the threshold of 1% PEL: Petiole length; LIL: Limb length; LIW: Limb width; FND: 50% Flowering days number; PLH: Plant height; DIS: Diameter of the stem; PRN: Primary ramification numbers; FWL: Fresh weight of the leaves; FWS: Fresh weight of the stems; PLE: Pedoncule length; FRL: Fruit length; FRW: Fruit width*

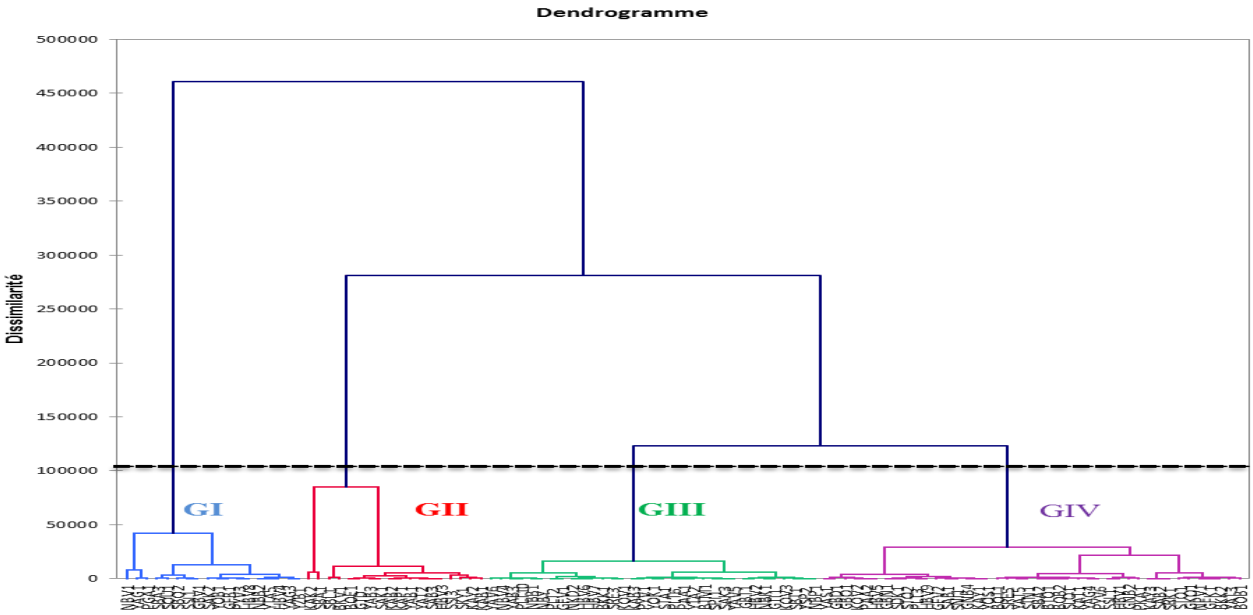



Figure 8: Dendrogram of Dissimilarity among 111 accessions of *C. olitorius* using Ward's Minimum Variance Method of Cluster Analysis

the 4 groups obtained on the basis of the characters related to the size (PLH, DIS, PRN and FWS) and parameters of the leaf output (PEL, LIL, LIW, FWL). As mentioned in figure 9, axis 1 is positively correlated with the parameters, diameter of stem (DIS), the height of the plant (PLH) and fresh weight of the stem (FWS), and negatively correlated with the number of primary ramifications (PRN). On the other hand axis 2 represents the leaf output. These results are confirmed by the test of Lambda de Wilks (value of 0.025) in factorial discriminating analysis which gives values of F observed and F critical respective of 10.22 and 1.46 with an increase in value < 0.0001 to the threshold of 5% between the 4 obtained groups and it was showing that they have many distinct entities. The relation of the groups with the axes shows that groups 1 and 4 are opposed and strongly correlated to axis 1 (Figure 10). Groups 2 and 3 on the other hand are correlated with the two axes in a negative and positive way respectively.

### 3.8.2 Average performance of the groups

Results of variance analysis consigned in table 8 which indicated that the characters like limb length, stem diameter, fresh weight of the leaves and that of the stems discriminate the four groups

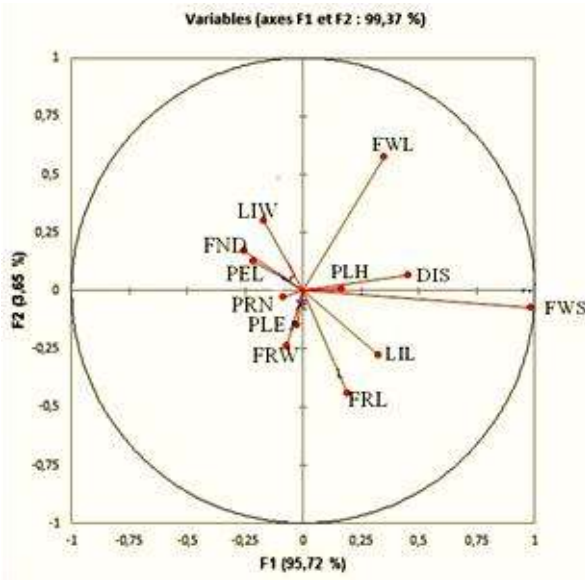



Figure 9 Projection of the variables measured on the first two axes

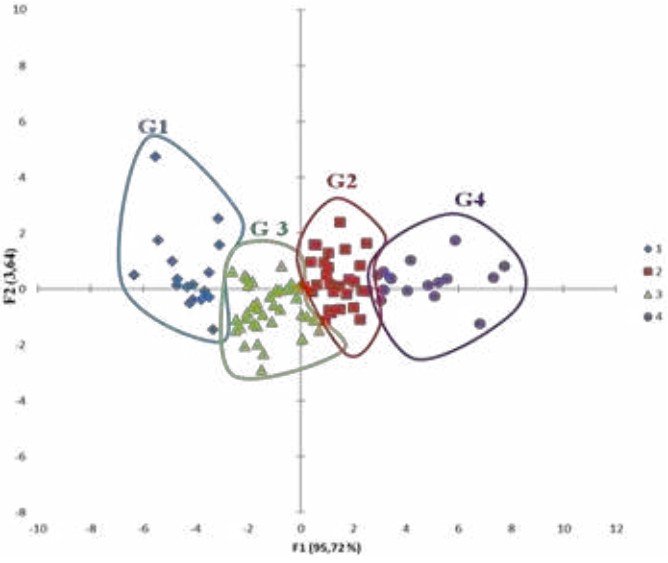



Figure 10 Position of the agro-morphologic groups of the C. olitorius in factorial analysis

Table 8: Performance of the 4 groups resulting Cluster Analysis

| Characters | Group 1 (18) | Group 2 (33) | Group 3 (42) | Group 4 (18) | F Genotype |
|---|---|---|---|---|---|
| **PEL** | 5.84[a] | 5.2[a] | 5.39[a] | 5.18[a] | 1.52[ns] |
| **LIL** | 12.63[a] | 14.21[b] | 13.92[b] | 14.45[b] | 4.94[**] |
| **LIW** | 5.75[a] | 5.18[a] | 5.22[a] | 5.24[a] | 2.28[ns] |
| **FND** | 61.8[b] | 59.50[ab] | 59.93[ab] | 58.66[a] | 1.81[ns] |
| **PLH** | 135.36[a] | 136.17[a] | 136.22[a] | 140.53[a] | 1.42[ns] |
| **DIS** | 1.98[a] | 2.08[b] | 2.03[ab] | 2.201[c] | 11.34[**] |
| **PRN** | 14.88[a] | 14.44[a] | 14.71[a] | 14.01[a] | 0.11[ns] |
| **FWL** | 206.59[a] | 233.11[b] | 194.82[a] | 236.5[b] | 9.27[**] |
| **FWS** | 445.50[a] | 624.88[c] | 552.72[b] | 730.43[d] | 196.63[**] |
| **PEL** | 0.43[a] | 0.42[a] | 0.43[a] | 0.43[a] | 0.31[ns] |
| **FRL** | 6.17[a] | 6.40[ab] | 6.52[b] | 6.57[b] | 2.59[ns] |
| **FRW** | 0.48[a] | 0.47[a] | 0.53[a] | 0.46[a] | 0.76[ns] |

*PEL: Petiole length; LIL: Limb length; LIW: Limb width; FND: 50% Flowering number days; PLH: Plant height; DIS: Diameter of the stem; PRN: Primary ramification numbers; FWL: Fresh weight of the leaves; FWS: Fresh weight of the stems; PLE: Pedoncule length; FRL: Fruit length; FRW: Fruit width; CV: Coefficient of variation; F: Value of Fisher; *: significant difference at 5%, **: significant difference at 1%, ns: non-significant difference*

significantly. The groups show the following characteristics:

- Group 1 made up of eighteen (18) accessions which gather the individuals with a high semi-flowering cycle and with very weak morphological performances such as reduced height and low diameter of stem with weak leaf outputs;
- Groups 2 and 3 made up of thirty-three (33) and forty-two (42) accessions respectively and characterized by individuals with average performance and have semi-flowering cycle,
- Group 4 made up of eighteen (18) accessions, which are opposite to the group 1 and are characterized by individuals with precocious semi-flowering cycle and very high morphological performances in characteristics like petiole lengths, stem diameter, fresh weight of leaf and stem very significant.

Results of this study revealed the effects of each factor agro-climatic zone and botanical variety (table 9) and showed that these two factors do not have significant effects on the structuring of diversity.

Table 9 Agro-climatic zones effect and botanical variety on structuring of diversity

| Characters | Groups Effectives | Group 1 (18) | Group 2 (33) | Group 3 (42) | Group 4 (18) |
|---|---|---|---|---|---|
| **Agro climatic zone** | North-sudanese | 9 | 8 | 16 | 3 |
| | Sahelian | 1 | - | 2 | 1 |
| | South-sahelian | 6 | 21 | 20 | 12 |
| | South-sudanese | 2 | 4 | 4 | 2 |
| **Variety** | V1 | 12 | 29 | 33 | 17 |
| | V2 | 6 | 4 | 9 | 1 |

*V1 : C. olitorius var olitorius L. ; V2 C. olitorius var incisifolius Asch. & Schw*

## 4 DISCUSSION

Variation in the vernacular name within various ethnic groups would be related to a deformation of original name or the existence of many autonomous sub-groups among these ethnic groups. Similar types of observations were made by Dansi et al. (2008a), Dansi et al. (2008b) and Dansi et al. (2009) on Leafy-vegetables grown in Benin and Adoukonou-Sagbadja et al. (2006) in the fonio. In addition, the adoption of names of one ethnic group by another was reported by Ta-Bi et al. (2016) on species of the genus Corchorus in Cote d'Ivoire. According to Doh (2015) this adoption tends to disregard local names for the younger generations. As a result, traditional nomenclature remains imprecise and incomplete.

The uses of the leaves phenotypic characters for the description of this species are very common and also used by Berhaut (1967) and Mbaye (2002). Relying on the leaf form and the nature of leaf margin, these two authors identified two varieties of *C. olitorius* species viz *C. olitorius var olitorius* and *C. olitorius var incisifolius*. The morphotype "*bulvak moaga*" or "bulvak raogo" are identical to the variety *C. olitorius var olitorius* while the morphotype "bulvak yanga" are identical to the variety *C. olitorius var incisifolius*. Identification of the morphotypes and denominations by relying on the morphological characteristics could be explained by the fact that the mode of selection by producers is purely based on the phenotypical nature. Similar observations have already been reported on sorghum (Sawadogo, 2015) and African cabbage (Kiébré, 2016). Moreover, the denomination according to the probable source or ethnic group that introduced the first seeds shows that the morphotype with the bright green-light leaves would be a variety introduced in Burkina Faso through the migration of population.

Methods of seed acquisition identified in this study are widely known and formerly reported by many researchers (Sawadogo, 2015; Kiébré, 2016). Variation in seed storage as per the localities would be related to the importance of plant in each locality. Indeed in urban and semi-urban areas, this vegetable is generally grown for the marketing of leaves. As a result, their seeds are bought from the markets by traders who brought these seed from the country or some neighboring countries.

The growing of *C. olitorius* all the season would be related to the socio-economic interest of the plant for the population. Along with its use as a mucilaginous leafy vegetable, it also constitutes a source of income for the local households. Increasing demand and household income generation pushed farmers to make available fresh leaves throughout the year and to meet the increasing demand effectively. Indeed, spontaneous collection of *C. olitorius* under natural habitats became rare because of some farming practices such as the use of weed killers and/or the deep ploughing by the tractors. According to Mbaye (2002) at 5 cm of hiding, the rate of germination of seeds becomes low and it becomes null at 10 cm. Further, excess use of chemical products modifies the composition of the nutritional elements of the plant which causing serious consequences on human health (Komlan et al., 2013).

The prevalence of women in the production and selling of pot corète could be explained by the sociocultural beliefs. Indeed,

according to this investigation, the management of vegetables is an exclusively female activity. These results corroborate with the findings of Faure & Labazee, (2002); Komlan et al. (2013) which suggest two concepts of African town's socio-economy i.e. (i) gender segregation is based on the nature of the activities and (ii) sexual characterization centered on the profitability at the scale of the activities.

The agro-morphological evaluation of 111 accessions of Burkina Faso revealed the existence of several discriminating natures which translating very higher morphological diversity within the studied area. These observations shows similarities with the diversity reported by of Islam et al. (2002) and Ghosh et al. (2013) on germplasm accessions from the Bangladesh Jute Research Institute (BJRI) and Adebo et al. (2015) on accessions from Benin.

The agromorphologic characterization revealed the existence of a great phenotypic diversity. This observed diversity is an expression of strong genotypic heterogeneity which could be confirmed by molecular analyses also. Moreover, this diversity is more significant than that observed by Kiébré (2016). This higher genetic diversity can be explained by the big size of study area. This diversity is significantly different as compared to the number of morphotype describes by the peasants. Further, by relying on the color of the stem five morphotypes were identified during the study while this was reported only two by the peasants. That could be explained by the fact that the color of pot corète stem is not a character of interest for the producers. Moreover, the red color of the stems may be because of the accumulation of anthocyanine in plant cells (Dicko et al., 2005; Omondi-Wasonga, 2014), which is not a characteristics of interest for the producers. The significant and positive correlation was reported between the 50% flowering number of days (FND) and numbers it primary ramifications (PRN) and it was reported similar to that of Kiébre (2016). According to these authors, late accessions have been able to develop their vegetative apparatus and express as well as possible their growth potential by producing many ramifications. In addition, the positive correlations between the plant diameter (DIS) and the leaf output (FWL) indicates strangeness of the stem which allowing certain stability by allowing an important production of the leaves. Moreover, positive correlation between the length of the limb and the fresh weight of the leaves indicates that the accessions with thin and long limb have a good leaves output. This shows that for an important production leaf output, the selection should be directed towards the accessions with the thin and long leaves

The structure diversity independently to the varietal type would be related to a strong resemblance of the morphological characters between the two botanical varieties. Indeed, according to Mbaye (2002) the coefficient of resemblance between the two varieties is very high (S = 86.39%).Thus, these two variety are morphologically identical except to form of leaves and margin of the laves. Group 4 made up of individuals with high agro morphologic performance could be used as elite parents for future work of selection and improvement. Moreover an improvement of group1 in view of a reduction of the cycle could increase foliar biomass of this group.

**CONCLUSION:**

In this study two botanical varieties are distinguished by the peasants, a variety which widely grown called "*bulvank yanga*" and another semi-cultivated called "*bulvank moaga*" or "bulvank raogo". The pesants denominations of the varieties refer especially to the morphological characters of the leaves. Moreover the growing and marketing of the pot corète is an economic activity for women.

The agro-morphologic characterization revealed the existence of several discriminating natures thus translates the existence of a significant agro-morphological diversity within the accesions. This diversity was structured in 4 morphologies groups on the basis of the whole of the quantitative characters. The structuring is independent of the agro-climatic factors zones and botanical variety. The group 4 made up of eighteen (18) accessions is characterized by individuals with precocious semi-flowering cycle and very high morphological performances (PEL, FWL, FWS and DIS). Group could be useful for future work of selection.

**CONFLICT OF INTEREST**



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**REFERENCES**

Adebo HO, Ahoton LE, Quenum F, Ezin V (2015) Agro-morphological Characterization of *Corchorus olitorius* Cultivars of Benin. Annual Research & Review in Biology 7: 229-240. DOI: 10.9734/ARRB/2015/17642.

Adoukonou-Sagbadja H, Dansi A, Vodouhè R, Akpagana K (2006) Indigenous knowledge and traditional conservation of fonio millet (*Digitaria exilis, Digitaria iburua*) in Togo. In: Hawksworth DL, Bull AT (Eds.) Human Exploitation and Biodiversity Conservation, Springer Publication Netherlands 3: 39-55. DOI: 10.1007/978-1-4020-5283-5_4.

Berhaut J (1967) Flore du Sénégal. 2ème édit. Clairafrique-Dakar, Pp. 485.

Dansi A, Adjatin A, Adoukonou-Sagbadja H, Faladé V, Adomou AC, Yedomonhan H, Akpagana K, de Foucault B (2009) Traditional leafy vegetables in Benin: Folk nomenclature, species under threat and domestication, Acta Botanica Gallica 156 : 183-199. DOI: http://dx.doi.org/10.1080/12538078.2009.10516150.

Dansi A, Adjatin A, Adoukonou-Sagbadja H, Faladé V, Yedomonhan H, Odou D,. Dossou B (2008a) Traditional leafy vegetables and their use in the Benin Republic. Genetic Resources and Crop Evolution 55: 1239-1256. DOI: 10.1007/s10722-008-9324-z.

Dansi A, Adjatin A, Vodouhè R, Adéoti K, Adoukonou-Sagbadja H, Faladé V, Yédonou H, Akoègninou A, Akpagana K (2008b) *Biodiversité des légumes-feuilles traditionnels consommés au Bénin,* libre ISBN : 978-99919 -68 -63 -6 . 187p.

Dicko MH, Gruppen H, Barro C, Traore AS, van Berkel WJ, Voragen AG(2005) Impact of phenolic compounds and related enzymes in sorghum varieties for resistance and susceptibility to biotic and abiotic stresses. Journal of Chemical Ecology 31: 2671-2688. doi:10.1007/s10886-005-7619-5.

Doh KS (2015) Plantes à potentialité antidiabétique utilisées en médecine traditionnelle dans le District d'Abidjan (Côte d'Ivoire) : étude ethnobotanique, caractérisation tri phytochimique et évaluation de quelques paramètres pharmacodynamiques de certaines espèces. Thèse de Doctorat de l'Université Félix Houphouët Boigny de Cocody-Abidjan (Côte-d'Ivoire), UFR Biosciences, Pp.150.

Faure YA, Labazee P (2002) Socio-Economie des Villes Africaines : Bobo et Korogho dans les Défis de la Décentralisation, *IRD, Editions Karthala, Paris.*

Ghosh RK, Sreewongchai T, Nakasathien S, Phumichai C (2013) Phenotypic variation and the relationships among jute (*Corchorus* species) genotypes using morpho-agronomic traits and multivariate analysis. Australian Journal of Crops Science 7: 830-842.

Islam MR, Islam MM, Akter N, Ghosh RK (2002) Genetic Variability and Performance of Tossa Jute *(Corchorus olitorius).* Pakistan Journal of Biological Sciences 5 : 744-745.

Kiébré Z (2016) Etude De La Diversite Genetique d'une Collection De Caya Blanc (Cleome Gynandra L.) Du Burkina Faso, Thèse Unique de Doctorat, Université de Ouagadougou (Burkina Faso), Pp. 139.

Komlan C, Adegbola P, Adegbidi A, Adetonah S, Mensah GA (2013) Analyse des systèmes de commercialisation de la corète potagère (*Corchorus olitorius L.*) produite à Agbédranfo au Sud-Ouest du Bénin (Département du Couffo). *Intemational Conference of the African Association of Agricultural Economists*, September 22-25, 2013, Hammamet, Tunisia.

Kundu A, Sarkar D, Mandal NA, Sinha MK, Mahapatra BS (2012) A secondary phloic (bast) fibre-shy (bfs) mutant of dark jute (*Corchorus olitorius* L.) develops lignified fibre cells but is defective in cambial activity. Plant Growth Regulation 67:45–55. doi: 10.1007/s10725-012-9660-z.

Marchenay P, Lagarde MF (1986) Guide de prospection-A la recherche des variétés locales de plantes cultivées. Groupe de recherche et de développement sur le patrimoine génétique animal et végétal de la région Provence-Alpes-Côte d'Azur, Pp. 211.

Mbaye MS (2002) Contribution A L'étude Biosystématique Du Genre *Corchorus* L. (Tiliaceae) Au Sénégal. Thèse Unique, Université Cheikh Anta Diop De Dakar

Mbaye MS, Noba K, Sarr RS, Kane A, Sambou JM, Amadou Tidiane BA (2001) Elements de precision sur la systematique d'especes adventices dugenre corchorus l. (tiliaceae) au Senegal. African Journal of Science and Technology 2 : 51-64. DOI:

http://dx.doi.org/10.4314/ajst.v2i1.44639.

Millogo-Rasolodimby J (2001) *L'Homme, le climat et les ressources alimentaires végétales en périodes de crise de subsistance au cours du 20ème siècle au Burkina faso.* Thèse Doctrate, University of Ouagadougou, 249 p.

Olivier-Beever B (1986) Medicinal plants in Tropical West Africa. Cambridge University Press, Pp 25- 262.

Omondi -Wasonga D (2014) *Phenotypic characterization of kenyan and south african spider plant* (Cleome gynandra *L.) ecotypes*, PhD Thesis submitted to the University of Nairobi, Pp.110.

Sawadogo N (2015) *Diversité génétique des sorghos à grains sucrés [Sorghum bicolor (L.) MOENCH] du Burkina Faso,* Thèse Unique de Doctorat, Université de Ouagadougou (Burkina Faso), 185 p.

Ta-Bi IH, N'Guessan K, Bomisso EL, Assa RR, Aké S (2016) Etude Ethnobotanique De Quelques Espèces Du Genre *Corchorus* Rencontrées En Côte d'Ivoire. European Scientific Journal 12 : 415.