EJSIT
European Journal of Science, Innovation and Technology
ISSN: 2786-4936
www.ejsit-journal.com
Volume 6 | Number 2 | 2026

Analysis of the Vegetative Characteristics of Four Varieties of Cowpea (*Vigna Unguiculata*) Grown in Two Seasons in the Province of Maniema (D.R. Congo)

MWISSA MUSOKE Venant[1,2,7*], MOKE LUKUSA Bopole[1,7], BONONGA OKANI Juré[3], ALIANGO UVON Blaise[4], PALUKU NZIABAKI Augustin[5], NGAMA BOLOY Faustin[5], DHED'A DJAILO Benoit[6], YENGA BOMBEKU Dimanche[5,7]

[1]Faculty of Agricultural Sciences, University of Kindu, D.R. Congo

[2]D.E.S/Phytotechnics program; Yangambi Faculty Institute of Agricultural Sciences, Kisangani, D.R. Congo

[3]National Institute for Agronomic Study and Research of Yangambi (INERA-Ybi), D.R. Congo

[4]University of Bunia, D.R. Congo

[5]Yangambi Faculty Institute of Agricultural Sciences, Kisangani, D.R. Congo
P.O. Box 1232 Kisangani and P.O. Box 28 Yangambi, DRC

[6]Faculty of Science, University of Kisangani, D.R. Congo
P.O. Box 2012/Kisangani

[7]Laboratory of Eco-agriculture and Tropical Agroforestry (LEAT), IFA Yangambi, R.D. Congo

ABSTRACT

Cowpea (*Vigna unguiculata*) is a dietary legume of great importance for food security and nutrition in several parts of Africa. In the Maniema Province of the Democratic Republic of Congo, this crop is widely practiced by local farmers, but information on the morphological variability of these varieties under the same environment and during the different seasons is very limited. A situation that hinders the efficient use (cultivation) of varieties of this crop, particularly in the Province of Maniema. Thus, this study mainly aims to determine the characteristics of these four varieties as well as their variations according to species and seasons. To achieve this objective, these varieties were evaluated on the basis of morphological and agronomic descriptors relating to vegetative parameters, in particular the height or length of the plants, the diameter at the collar of the plants, the leaf area, the number of nodules, etc. The data collected were subjected to statistical analyses for possible differences between the varieties studied as well as between the two seasons observed. The results obtained showed significant morphological variability between the varieties observed. Some varieties showed more vigorous vegetative growth (high height and diameter for VITA7) and greater leaf development (high surface area for H4). This morphological diversity reflects the existence of an exploitable genetic potential for varietal improvement and adaptation of cowpea to local agro-ecological conditions.

Keywords: cowpeas, diversity, performance, variety, Maniema

INTRODUCTION

Dietary legumes are a better source of nutrition after cereals because of their importance to humans and animals (Singh et al., 2000). In addition, they have many functional and nutritional properties that ensure food safety.

* Corresponding Author

Cowpea is a very widespread crop in the D.R. Congo with a growing impact on the diet of the Congolese, where it occupies a crucial place because more or less 65 % of the population consumes cowpea seeds (Baoua et al., 2012; IPA, 2017). Cowpea is a grain legume containing about 20 to 30 % protein and its consumption helps to fight malnutrition (Adigoun, 2002; Rabe et al., 2017); hence the term "poor man's meat" (FAOSTAT, 2010). Productions are often underestimated, especially in Africa where cowpea is grown mainly in association with cereals, with particularly low yields of 240 to 300 kg/ha (Rachie, 1985).

From a physiological point of view, this plant has good adaptability to poor pedoclimatic conditions, cowpea is considered to be one of the most drought-tolerant legumes (Singh et al., 2002). However, cowpea is one of the species with high genetic diversity in D.R. Congo (Singh, 2002). Its accessions are adapted to different climatic conditions and to very varied cultivation practices; They are therefore transmitted uninterruptedly from generation to generation in domestic gardens that are an essential space for the conservation of this resource.

In addition, in Maniema, cowpea is grown either in association or in pure form and on family farms, it is mainly varieties from elsewhere (IPA, op.cit.). Indeed, compared to the varieties of the study environment, very little research has been done.

Even if molecular markers are increasingly used, morphological descriptors, despite the influence of environmental factors, remain relevant for preliminary characterization work. Certain characteristics of the seeds, such as colour and texture, allow farmers to better separate varieties.

Also for an efficient exploitation of cowpea germplasm in Maniema and in order to safeguard it from possible disappearance, the objective of this study is to characterize and evaluate the morphological variability of cowpea accessions collected in the territories of the Maniema Province. This characterization was based on vegetative parameters; successful varieties and traits that have proven to be interesting can be used for future breeding and varietal improvement work.

MATERIALS AND METHODS

Midfield

To monitor cowpea varieties, the materials collected in the territories were installed in a collection in Kindu, the capital of the Maniema Province. The experimental site of this study was located at the Malonga block located 8 km north of the City of Kindu and the study took place during the year 2024, with the first installation of the experimental field taking place in March (Season A or S1) and the second in September (Season B or S2).

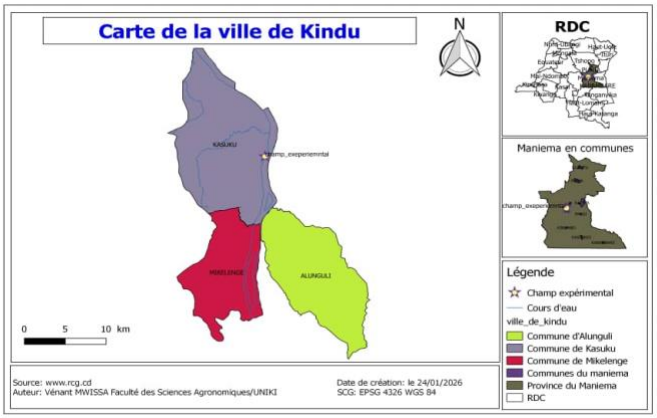


Figure 1. Location map of the experimental field

The Province of Maniema enjoys a hot and humid climate of the Aw4 type of the Köppen classification (Makondambuta, 1997). However, the experimental site (collection) was installed in the part with sandy-clay soils. Two major plant formations cover Maniema: the dense humid forest and the savannah. However, the vegetation of the experimental site is characterized by fallow; the plant species encountered in this area before the establishment of the culture were: Pueraria javanica, Epatorium odoratum, Elaeis guineensis.

Hardware

The biological material used consisted of cowpea varieties collected from farmers in the study area in the province to install them in the experimental field in Kindu. Hence; V1 = Variety VITA7, V2 = Variety MUYAYA, V3 = LOCAL Variety and V4 = Variety H4.

Methods

Experimental set-up

This study was based on the accelerated participatory research method (MARP) which consists of documentation, investigation and field observation from a device that was made up of elongated plots distributed in a block repeated once within which each plot represented a variety of the environment. The plot dimensions were 8 m in all directions, separated from each other by 2 m. The experimental field had an area of 684 m^2; i.e. 38 m long and 18 m wide, including 512 m^2 of space covered by varieties; from which each varietal plot consisted of 160 vines.

Conduct of the test

These are mainly the preparation of the land (choice, preparation and delimitation of the land, land clearing, stump removal and cleaning); ploughing; the delimitation of plots and the staking of sowing lines; labelling and signage; from sowing to spacings of 80 x 50 cm due to 3 seeds per pocket; maintenance (restocking of voids and manual weeding at 15 days after sowing at two-week intervals from each other) as well as picking the pods by hand uprooting.

Data collection

A total of 11 parameters were examined visually and by measurements, namely: emergence rate/variety in % (TL) at 7 days after sowing by the ratio between the poquets raised on the set of pockets sown times 100; sowing-flowering time (DSF) by counting the number of days from sowing to the appearance of the first flower; flower color (CFl); seed colours and shapes (CFGr); stem port (PT); mean number of nodules per plant at 30 days after sowing (NMNP) by manual count; mean plant height at 30 days after sowing in cm (HMP) with the tape measure from the collar to the top of the apical leaf for erect and semi-erect varieties; average length of the plant at 30 days after sowing in cm (LMP) with the tape measure from the collar to the apical leaf for the creeping variety; average diameter at the crown of the plant at 30 days after sowing in mm (DMP) with the caliper at the collar at 5 cm from the ground; average leaf area of one plant in cm^2 (SF) from the non-destructive method; vegetative cycle (VC) by counting days from sowing to harvest.

Data were taken according to the recommendations in the cowpea descriptors (IBPGR, 1983) and from Cobbinah et al. (2011).

Statistical data analysis

The data collected were entered on an Excel spreadsheet in the form of a "accessions x morphological characters" matrix. The analysis of morphological data was essentially descriptive. The ANOVA test was performed followed by the Tukey HSD test to understand the averages. The evaluation of the structuring of the morphological diversity of the varieties was done by a Correspondence Factor Analysis (MFA), a Ascending Hierarchical Classification (HFA) and a Principal Component Analysis (PCA). The software used is that of R 4.3.2 on its RStudio interference.

PRESENTATION OF RESULTS AND DISCUSSION

Results

Emergence rate of the varieties experimented

The four cowpea varieties tested showed different seed emergence rates, the values of which are presented in Table 1.

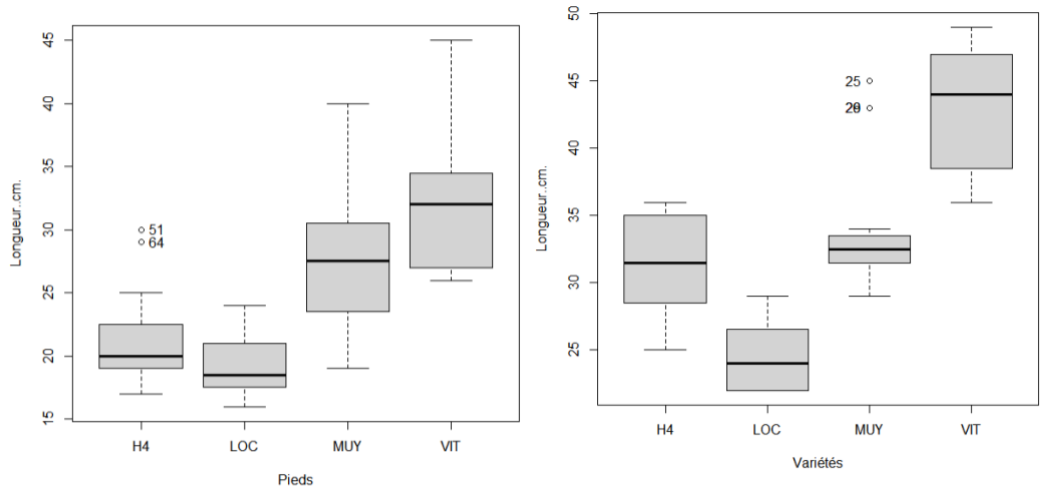
Table 1. Seed emergence rate

	Seeds / S1			Seeds / S2	
Varieties	Sown	Emerged	(%)	Emerged	(%)
VITA 7	16	13,12	82	15,84	99
Muyaya	16	14,24	89	15,52	97
Locale	16	15,04	94	14,88	93
H4	16	14,72	92	15,04	94

Table 1 shows that seed emergence of all four varieties in the first season ranged from 82 % for the Vita7 variety to 94 % for the local variety, making the average of the trial calculated at 89.25 %. However, these differences were not confirmed by the univariate proportion test which indicated a p-value = 0.09453121 at the 5 % level. Similarly, for the second season, the average of the trial between the highest and lowest emergence rate was 95.75 %. All the varieties in the trial behaved in the same way with regard to seed emergence after 7 days of sowing.

Plant Height and Length

Figure 2 shows the heights and lengths of the plants in evolution in the two seasons (S1 and S2), i.e. 30 days after they were installed in the field.



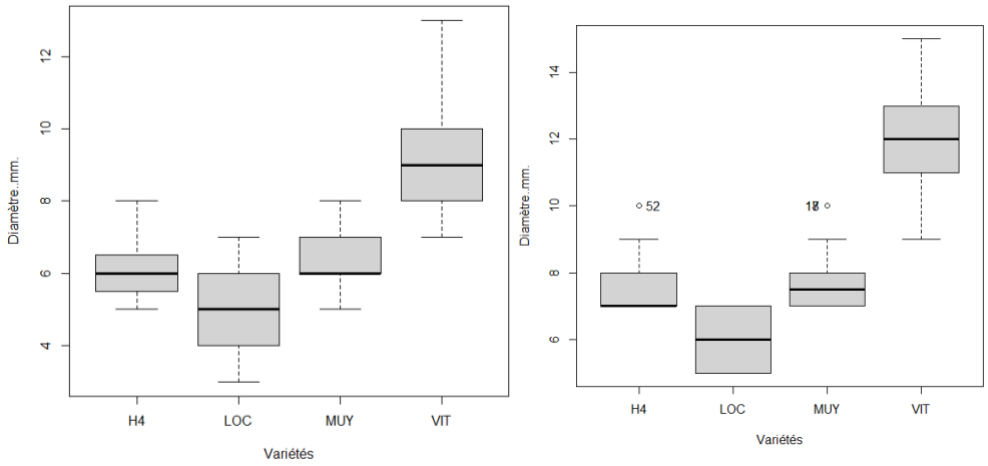
S1 Plant Heights S2 Season Plant Heights

Figure 2. Dispersal of values around average plant lengths in 30 days

The overall comparison of the two figures suggests that the variability of vegetative growth depends on both variety and seasonal conditions. The Vita7 strain stands out for its more vigorous and relatively stable growth, while Muyaya has more variability between plants. The H4 and local varieties, although showing more moderate growth, have a relatively low dispersion, which could indicate greater morphological homogeneity.

Growth in diameter of the varieties tested (mm)

Figure 3 shows the average stem diameters of the four varieties measured after 30 days of planting.



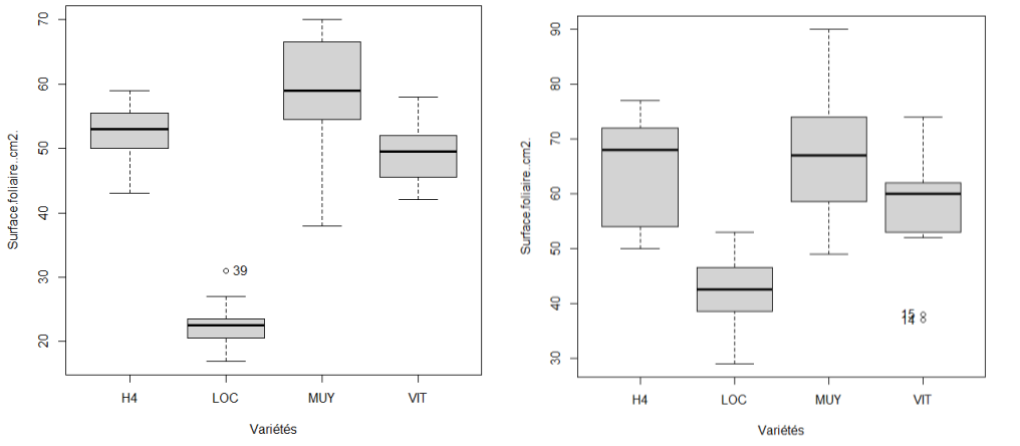
Diameters of S1 plants Diameters of S2 plants

Figure 3. Dispersion of the average diameters of the stems of two seasons

Reading Figure 3 shows that under the growing conditions installed in Kindu, there is a difference in diameter depending on the variety with the Vita7 variety presenting systematically higher values, followed by the close intermediate values obtained by the H4 and Muyaya varieties, while the local variety seems to have the smallest diameters; This trend has not changed in these 2 seasons. Thus, this variability is marked by a greater dispersion for the variety Vita7 in contrast to a low and comparable dispersion for the varieties H4 and Muyaya, which is moderate but concentrated at low values for the local variety.

Dispersion of leaf area values

Figure 4 shows the dispersion of the values obtained by measuring the leaf area of the varieties under test.



Leaf area (cm^2) S1 Leaf area (cm^2) S2

Figure 4. Dispersion of leaf area (cm^2) values of plants in two seasons

It is apparent from Figure 4 that during these two seasons, the trends of these different varieties gave high values ranging from 58 to 68 cm^2 for the Muyaya variety, values close to Muyaya variety ranging from 50 to 71 cm^2 for the H4 variety, intermediate values ranging from 46 to 52 cm^2 for the Vita7 variety and lower values ranging from 22 to 48 cm^2 for the variety local area. However, the distribution of the leaf area of these four varieties shows for

the Local variety, a moderate but concentrated dispersal towards low values and the most important dispersal for the variety Muyaya (wide leaf extent) while for the varieties H4 and Vita7, it is indeed a question of moderate variability and relatively low dispersal. This proves significant differences between the local variety and all other varieties, and probably between Vita7 and the H4–Muyaya group.

The stems of these varieties have presented three colours which are light green for the leaves of the Muyaya variety; dark green for the Vita7 variety and an intermediate green colour for the H4 and local varieties. It should be noted that these two parameters (shape and colour of the leaves) did not vary according to the seasons for each of the 4 varieties. The same is true for the growth habits of the plants in the first and second seasons, which have remained identical, i.e. creeping for the local variety.

Average flowering time of four varieties studied

Table 2 presents the average flowering times of the plants of four cowpea varieties tested in two different seasons.

Table 2. Flowering time of four varieties

Varieties	Flowers/ Season 1	Flowers/ Season 2	Medium
	Days	Days	Days
VITA 7	35	34	35,0
Muyaya	39	37	38,0
Locale	42	40	41,0
H4	36	36	36,0

Table 2 shows that the flowering time shows a varietal effect, with differences between the averages of about 7 days between the late-flowering (local) variety and the early-flowering variety (Vita7). For all varieties, the flowering time is slightly higher in season 1 than in season 2 with a decrease of 1 to 2 days depending on the variety. This trend suggests a slight seasonal effect, possibly linked to climatic conditions (temperature, rainfall,...), but the amplitude remains low.

The flower colours of these varieties were purplish for the varieties Vita7, Muyaya and H4; and white in colour for the local variety.

Colours and shapes of the seeds under observation

The seeds showed remarkable differences in colour and shape between these four cowpea varieties as shown in Table 3.

Table 3. Colours and shapes of cowpea seeds observed

	Seed Descriptor	
Varieties	Color	Shape
VIT	(3)	(2)
MUY	(4)	(1)
LOC	(1)	(4)
H4	(4)	(3)

Legend: - Colors: (1): White; (2) : Black ; (3): Brown and (4): Red
- Forms: (1): globular; (2): Elongated flattened; (3): Flattened globular and (4): Flattened

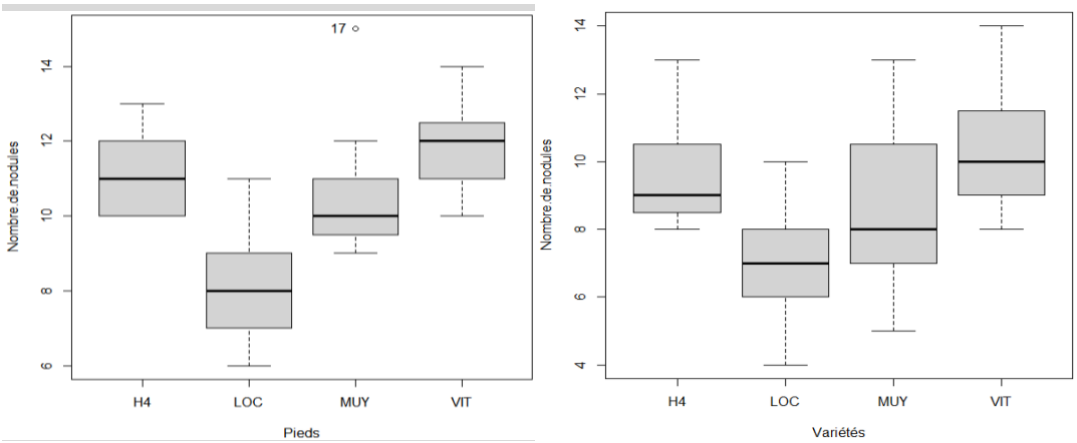
A reading of Table 3 specifies that the colour red was the most represented, appearing in two varieties (Muyaya and H4), i.e. 50 % of the total population. The colours white (local) and brown (Vita7) are each represented by a single variety, corresponding respectively to 25 % of the sample. Black seeds were not observed among the varieties studied. This

distribution reflects a moderate qualitative diversity of the "color" trait, with a predominance of the red phenotype.

As far as the shape of the seeds is concerned, the four modalities described (globular, elongated flattened, flattened globular and flattened) are all represented, each by a single variety (25 %). This homogeneous distribution of modalities indicates a high morphological diversity for the form character of cowpea seed in the Province of Maniema.

Average number of nodules per variety

The morphological trait observed in the subsoil part of these different cowpea varieties was nodulation as illustrated in Figure 5.



Average number of nodules per plant (S1) Average number of nodules per plant (S2)

Figure 5. Average number of nodules per plant of varieties

The average number of nodules per plant was relative to the different varieties. In both seasons (S1 and S2), the Vita7 variety appears to be the most favourable to nodulation while the local variety was the least favourable with a low number of nodules. However, the H4 and Muyaya varieties showed intermediate values.

Vegetative cycles of the varieties collected

Table 4 shows the growing cycles of all varieties followed in two different seasons.

Table 4. Vegetative cycles of cowpea varieties under observation

	Growing cycles		Varietal
Varieties	1st season	2nd season	average
VIT	90	89	89,5
Muy	99	98	98,5
Loc	112	110	111,0
H4	98	95	96,5

This table shows that the differences between the earliest variety (Vita7) and the later variety (local) are about 22 days. Thus, the Vita7 variety can be considered a short-cycle variety, suitable for areas with a short growing season, while the local variety is a late variety, potentially more demanding in terms of growing time.

Discussion

The objective of this study was to characterize and evaluate the morphological diversity of local cowpea varieties collected in different territories of the Maniema Province. The results obtained reveal a significant morphological variability, both in terms of qualitative

characteristics (leaf shapes and colours, flower colour, etc.) and in terms of quantitative characteristics (stem heights and lengths, stem diameters, etc.).

The present study made it possible to assess the current state of cowpea diversity on the one hand and to identify the performing varieties on the other hand. Analysis of traits such as flower color, seed color and shape, stem habit,... showed great variability within the collection studied. Similar results were obtained by Gbaguidi et al. (2015).

Joseph et al., 2014 obtained a 100 % emergence rate, a higher result than that of Kindu.

In addition to the white and purplish colors of the flowers found in this study, Cobbinah et al. (2011) carried out in similar work flowers of white-purple color and found a higher percentage of purple flower varieties, unlike Gbaguidi et al. (2015) of which 58 % of varieties had white flowers.

The average of 66 days after sowing (JAS) recorded for flowering of traditional varieties studied in Benin by Gbaguidi et al., op.cit. ; is higher than the results obtained in India by Makanur et al. (2013) and much higher than those obtained during the experiment in Kindu with 41 days for the local variety and by Cobbinah et al. cited above, who did a similar study in Ghana.

Very early varieties (53 JAS) were also identified by Doumbia et al. (2013) in Ghana. The earliness of cowpea varieties is an important agronomic characteristic that could help cope with climate change phenomena and particularly drought. This earliness can be assessed by the time it takes for the pods to bloom or ripen (Cobbinah et al., 2011; Gbaguidi et al., 2015). For Gbaguidi et al., 2015, more than half of the varieties studied had a cycle greater than or equal to 3 months, a result that corroborates with those of Kindu, but more widely superior to the results of François et al. (2013).

As for the average number of nodules, it was quite high in the variety Vita7; a result similar to that obtained by François et al., op.cit.

To maintain diversity, in situ and ex situ conservation strategies for these varieties are necessary. The Muyaya variety is an early variety with a 98-day cycle after sowing.

CONCLUSION

The objective of this study was to morphologically characterize and evaluate the vegetative performance of cowpea varieties (*Vigna unguiculata*) collected in the Maniema Province, Democratic Republic of Congo. The results obtained showed the existence of a significant morphological variability between the different varieties studied, particularly with regard to certain vegetative parameters such as plant height, leaf development and vegetative vigour.

This observed variability reflects the richness of local cowpea genetic resources cultivated by farmers in the region. Some varieties showed relatively superior vegetative performance, suggesting a better ability to adapt to local agroecological conditions. These morphological and agronomic differences constitute an important potential for the selection and varietal improvement of this legume.

In addition, the morphological characterization carried out in this study contributes to a better knowledge of local cowpea varieties, which are often poorly documented in the scientific literature. It is also an essential step in strategies for the conservation and development of agricultural plant genetic resources, particularly in a context where certain local varieties may be threatened by genetic erosion.

Ultimately, the results of this research highlight the interest of continuing the work of characterization and evaluation of local cowpea varieties, in particular through additional studies on production parameters, resistance to biotic and abiotic constraints as well as genetic analyses. These approaches will identify and promote high-performance varieties that can sustainably improve agricultural productivity and food security in Maniema province.

ACKNOWLEDGEMENTS

Our thanks go mainly to the CT Ir Msc MOKE LUKUSA Bopole, Mr. SWEDI FERUZI and the Provincial President of ASSIAC/Maniema, Ir ALPHONSE KITOKO Samuel for their collaboration and the granting of the land for the installation of the experimental field; but also to the engineers HEMEDI BINYONGO Pascal, KAHAMBA BARUANI Janvier and MWISSA KISSANGA Paul for their accompaniment in the field and without forgetting all those who provided their support and assistance.

REFERENCES

Adigoun F. A., 2002. *Impact of phytosanitary treatments of cowpea on the environment and the health of populations: the case of Klouékanmé and the lower Ouémé valley (BENIN),* Professional Master's thesis, pp 31–39.

Baoua I., Amadou L., Bakoye O., Baributsa D. and L. Murdock, 2012. *Technical sheet on the use of sand or ash for the conservation of cowpea seeds in a peasant environment*, Laboratory of Agricultural Entomology, Regional Centre for Agricultural Research of Niger (CERRA), Department of Entomology, 26p.

Cobbinah F., Addo-Quaye A. and Asante I., 2011. Characterization, evaluation and selection of cowpea (Vigna unguiculata (L.) Walp.) accessions with desirable traits from eight regions of Ghana. *Journal of Agricultural and Biological Science, 6*(7), 21, 32.

Doumbia I.Z., Akromah R. and Asibuo J.Y., 2013. Comparative study of cowpea germplasms diversity from Ghana and Mali using morphological characteristics. *Plant Breed Journal. Genet., 01*(03) 139-147.

FAOSTAT, 2010. *Agricultural production, crop primary database*. Food and Agricultural Organization of the United Nations, Rome.

François De Paul Mako N., Lassina Fondio, Brice Evrard Konan D., Hortense Andé D. and Christophe N'Guessan K., 2013. Study of the yield components of six improved varieties of cowpea [Vigna unguiculata (L.) Walp.]. *Journal of Applied Biosciences 63*: 4754 – 4762 ISSN 1997–5902, 9p.

Gbaguidi A. A., Assogba P., Dansi M., Yedomonhan H. and Dansi A., 2015. Agromorphological characterization of cowpea varieties grown in Benin. *Int. J. Biol. Chem. Sci., 9*(2), 1050-1066.

IBPGR, 1983. *Cowpea descriptors*. The Internacional Bord of Plant Genetic Ressources (IBPGR), secretariat, Rome, 29p.

IPA, 2017. *Annual report of agricultural activities in the agricultural production zones of Maniema.* Provincial Inspectorate of Agriculture. Maniema; RDC, pp 125.

Joseph Yoka, Jean Joël L., Julien Gaudence D., Marcel Houinato and Parisse Akouango, 2014. Adaptation of a cowpea cultivar (Vigna unguiculata (L.) Walp.) to the pedoclimatic conditions of Boundji (Republic of Congo). *Afrique SCIENCE 10*(1), 217-225 217.

Makanur B., Deshpande V.K. and Vyakaranahal B.S., 2013. Characterisation of cowpea genotypes based on quantitative descriptors. *Academic Journals, 8*(4): 1183-1188.

Makondambuta E., 1997. *Types of climate*. Congonline, Afriqu'Info asbl, Brussels, Belgium. Climate and the French-speaking International Secretariat for Environmental Assessment/Kindu Maniema 12p.

Rabe M., Baoua I. B., Sitou L. and Amadou L., 2017. Farmer Field School, a Participatory Approach to Improving Cowpea Yield: Results of Pilot Experiments Conducted in the Maradi and Zinder Regions of Niger, *African Agronomy, 29,* 1-9.

Rachie K.O., 1985. *Introduction in Cowpea research production and utilization*. Rachie K.O (eds). Wiley, New York, pp 21–28.

Singh B. B. and Ishiyaku M., 2000. Brief communication. Genetics of rough seed coat texture in cowpea. *Journal of Heredity, 91*(2), 170-174.

Singh B., Ehlers J., Sharma B. and Freire Filho F., 2002. *Recent progress in cowpea breeding*. IITA, Ibadan, Nigeria, pp 3-13.22-40.

Singh B. B., 2002. *Recent genetic studies in cowpea in challenges and opportunities for Enhancing Sustainable Cowpea Production*. IITA, Ibadan, Nigeria, pp. 3-13.