

**EVALUATION OF COWPEA VARIETIES ON A FIELD IN
BENIN CITY**

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**DEPARTMENT OF CROP SCIENCE,
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BENIN CITY.**

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**A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF
CROP SCIENCE, FACULTY OF AGRICULTURE, UNIVERSITY OF
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REQUIREMENTS FOR THE AWARD OF BACHELOR OF
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CERTIFICATION

This is to certify that this research was carried out by Abu Gideon IDEMUDIA (AGR1600269) of the Department of Crop Science, Faculty of Agriculture, University of Benin, Benin City.

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Date

PROF. K. E. LAW-OGBOMO
(Head of Department)

Date

DEDICATION

My research work is heartily dedicated to God almighty and my family (Philip) for their drive, motivation and inspiration given to me to this very moment.

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ABSTRACT

Cowpea *is* an important source of food, income and livestock feed. It has ability to improve marginal lands through nitrogen fixation and as a cover crop can protect against soil erosion. It is extensively cultivated under rain fed conditions mainly in the savanna zone of Nigeria. The objective of this study was to evaluate the performance of eleven cowpea varieties in an open field at UNIBEN. Nine cultivars and two local varieties were used for the experiment. The experiment was laid out in a Randomized complete block design (RCBD) with eleven treatments and three replications. The growth variables evaluated were leaf length, leaf width, leaf area, plant height, number of leaves per plant. Two variables were significantly different depending on variety. In the case of leaf width Samaru 14 produced the significant widest leaf width compared to the other varieties, whereas in the case of leaf area Samaru 15 produced the significantly wildest leaf area compared to the other varieties. Samaru 14 did best in leaf width whereas Samaru 15 did best in leaf area among the other varieties evaluated.

CHAPTER ONE

1.0

INTRODUCTION

Cowpea (*Vigna unguiculata* (L) Walp), a grain legume crop is an important source of food, income and livestock feed and forms a major component of tropical farming systems because of its ability to improve marginal lands through nitrogen fixation and as a cover crop. It is a valuable and reliable asset that brings income for many smallholder farmers and traders in sub-Saharan Africa (Langyintuo *et al*, 2003). The grain is also a good source of human protein, while the haulm is an important source of livestock protein (Fatokun, 2002). Cowpea is extensively cultivated in Nigeria under rain fed conditions, mainly in the savanna (CRI, 2006) and about 80% of the cowpea produced in Nigeria is grown largely in the savannah zone of the country (FAO, 1999). Even though a wide range of seed yields have been recorded for cowpea, yet, there yields are the least in the world, an average of 310 kg/ha (Ofosu-Budu *et al*, 2007).

Among the factors responsible for low yields are. liv use of local varieties and low soil "fertility, as most tropical soils are deficient in essential nutrients particularly N and P (Jones and Wild, 2015). Efforts were made to improve cowpea production in Nigeria through the introduction of new varieties (Addo-Quaye *et al*, 2011) and more productive agricultural technologies. None of these improved varieties could achieve optimal performance without appropriate and specific fertilizers. On the other hand,

fertilizers are limited in Nigeria agriculture (less than 8 kg/ ha) which is among the highest in Africa (FAO, 2005).

It has been suggested that organic manure should be used in place of chemical fertilizers

to avoid long-term negative effect of chemical fertilizer on the soil (Parr *et al.*, 1990).

However, organic manure is usually required in large quantities to sustain crop production and may not be available to smallholder farmers (Nyathi and Campbell, 2005). Cowpea does not require a high rate of nitrogen fertilizer because its roots have nodules in which soil bacteria called Rhizobia inhabit and help to fix nitrogen from the air into the soil in the form of nitrates.

1.1 Objective of the study

The study was carried out to evaluate growth performance of eleven (11) cowpea varieties in an open field at Benin city.

CHAPTER TWO

LITERATURE REVIEW

2.0

2.1 Cowpea taxonomy

Cowpea [*Vigna unguiculata* (L) Walp.] is a dicotyledonous crop in the family *Fabaceae*, subfamily *Faboideae* (Syn. *Papillionbideae*), tribe *Phaseoleae*, subtribe *Phaseolinae*, genus *Vigna* and section *Catiang*. It is a diploid plant containing 22 chromosomes and its nuclear genome size is estimated to cover 620 million base pairs (Timko and Singh, 2008). The genus was divided into sub-genera based upon morphological characteristics, the extent of genetic hybridization and geographical distribution of the species. The major groups consist of the African sub-genera *Vigna* and *Haydonia*, the Asian sub genus *Ceratotropis*, and the American sub-genera *Sigmoidotropis* and *Lasiopron* (Timko and Singh, 2008). *V. unguiculata* sub-species *unguiculata* includes four cultivated groups: *unguiculata*, *biflora* (or *cylindrical*), *sesquipedalis*, and *tejctilis* (Ng and Marechal, 1985). *Vigna unguiculata* subspecies *dekindiana*, *stenopJylla*, and *tennis* are intermediate wild progenitors of cultivated cowpea and form the major portion of the primary gene pool of cowpea. Fatokun and Singh (1987) pointed out that wild subspecies like *pubescence* do not readily hybridize and show some degree of pollen sterility and form a secondary gene pool.

2.2 Uses of Cowpea

Cowpea is a multipurpose crop, providing food for human and feed for livestock and it is a cash generating commodity for farmers, small and medium-size entrepreneurs. It has a wide variety of uses namely as a nutritious component in the human diet as well

as nutritious livestock feed. Cowpea can be used at all stages of growth as a vegetable crop. The tender green leaves are an important food source in Africa and are prepared as a pot herb, like spinach. Immature snapped pods are used in the same way as snap-beans^ often being mixed with other foods. Green cowpea seeds are boiled as a fresh vegetable, or may be canned or frozen. Dry mature seeds are also suitable for cooking and canning. Cowpea can also be used as a cover crop (Timko and Singh, 2008; Langyintuo *et al.*, 2003; Singh, 2002). The very early maturity characteristics of some cowpea varieties provide the first harvest earlier than most other crops during production period. This is an important component in hunger fighting strategy, especially in Sub-Saharan Africa where the peasant farmers can experience food shortages a few months before the maturity of the new crop. ' Its drought tolerance, relatively early maturity and nitrogen fixation characteristics fit very well to the tropical soils where moisture, erosion and low soil fertility is the major limiting factor in crop production (Hall, 2004; Hall *et al.*, 2002), In many areas of this world, cowpea is the only available high quality legume hay for livestock feed. Cowpea may be used green or as dry fodder. It can also be used for intercropping with other main crops like pearl millet (*Pennisetum glaucum*), maize, sorghum and cassava (*Manihot esculenta* L.). Cowpeas are sacred to Hausa and Yoruba tribes, and are prescribed for sacrifices to abate evil and to pacify the spirits of sickly children. Hausa and Edo tribes use cowpea medicinally one or two seeds are ground and mixed with soil or oil to treat stubborn bowels (Nkouannessi, 2005)

The protein found in cowpea is similar to the one from other legumes, rich in the essential amino acids lysine and tryptophan (Timko and Singh, 2008). However, the protein nutritive ' value of cowpea and other legumes is lower than that of animal proteins because they are deficient of sulfur amino acids and contain the non-nutritional factors (phytates and polyphenols), enzymes inhibitors (against trypsin, chymotrypsin and R-amylase) and hemagglutinins (Jackson, 2009). Minerals and vitamins are the other nutritional important constituents of the cowpea seeds. It was reported that folic acid, a vitamin B necessary during pregnancy to prevent birth defect in the brain and spine is found in higher quantity in cowpea compared to other plants (Timko and Singh, 2008; Hall *et al*, 2003). The total crude protein in foliage ranges from 14-21% and in crop residues; it is 6 - 8 %. The high protein content in all cowpea parts consumable by human and animal (leaves, stems, pods and seeds), is the key factor in alleviating the malnutrition among women and children and improvement of healthy status of the livestock in resource-limited households where regular access to animal protein is limited due to low economic status. Different dishes can be prepared from cowpea. The young tender leaves can be cooked and eaten as vegetable, the green pods can be cooked and eaten just like green beans, the seeds can be cooked when fresh (semi-ripe) and, when fully matured and dry and eaten as pulses. Several legumes are produced in Nigeria, but cowpea is preferred on account of its short life cycle, fodder use and quality. The dry seeds may be boiled and eaten with "Gari" (a cassava product). It is also boiled together with rice and a colouring agent to give

"Waakye". The boiled seeds could also be served with fried ripe plantain (Quaye *et al*, 2009). It is also used in preparation of weaning foods. In Nigeria and other African countries like Tanzania and Niger, cowpea is used for preparation of stew that is either used together with cereal dishes or directly mixed with the cereals as maize, wheat, sorghum and rice. In Nigeria, cowpea is boiled and also prepared in traditional dishes called "Gari" and "beans". The young leaves are used to prepare green sauce for different dishes. During the raining season, farmers can use immature pods to resolve their food problems before other crops are harvested.

2.3 Constraints to cowpea production in Nigeria

The major constraints to cowpea production in Nigeria are insect pests, diseases, drought and low soil fertility (ICRISAT, 2013). Chiezey *et al*. (1990) also identified absence of right strains of rhizobia in the soil as one of the constraints to cowpea production. Lack of inputs such as fertilizer, insecticides, improved seeds, poor cultural practices and lack of appropriate machinery for expanding planted area are other constraints experienced. Most cowpea crops are rain fed and although it is drought tolerant, cowpea farmers in the dry areas of sub-Saharan Africa obtain low yields, estimated at about 350 kg per hectare.

2.4 Fertilizer Use

Soil-fertility management range from recurring fertilizer applications to low external input agriculture based on organic sources of nutrients (Sanchez and Leakey, 1997). Although both extremes work well in specific circumstances, they pose major

limitations for most smallholder farmers in Africa. Fertilizer application in tropical agriculture has the potential "to dramatically increase production due to the highly weathered soils and the limited reserves of nutrients (Stewart *et al*, 2005) and therefore should be at the core of strategies to restore soil fertility and raise crop productivity. Over the years, there has been a rapid increase in fertilizer application worldwide as a result of the favourable policies which were created by introducing fertilizer subsidies and crop price-support programme and investment in distribution systems (Bumb, 1989). However, there has been a reduction in the use of fertilizer especially in sub-Saharan Africa (Sanchez and Leakey, 1997) due to several reasons ranging from high cost to availability. In Africa approximately 1.38 million tons of fertilizer per year is applied to cultivated lands resulting in an average fertilizer consumption of 8.3 kg /ha. This consumption represents only 2% of worldwide demand and the lowest in the world (Morris *et al*, 2007).

2.5 Constraints to mineral fertilizer use

Although mineral fertilizers can improve crop nutrition, they are sparingly used by farmers in Nigeria, as in many regions in sub-Saharan Africa, partly due to the prohibitive cost as a result of removal of government subsidies (Gerner *et al*, 1995). Sanginga and Woomer (2009) stated that fertilizer consumption pattern within nations in Africa are often sketchy and inconsistent. Most smallholder farmers in Africa use fertilizers, but they are seldom able to apply them at the recommended rates and at the appropriate time because of high cost, lack of credit, delivery delays, and low variable

returns (Heisey and Mwangi, 1996; Larson and Frisvold, 1996). Such constraints are largely due to the lack of an enabling policy environment in rural areas caused by the poor road and market infrastructure typical in most African countries. The price of fertilizers in rural areas of Africa is usually at least twice the international price '(Bumb and Baanante, 1996),

African countries subsidized fertilizers; however, the removal of fertilizer subsidies by most African governments has increased fertilizer prices in relation to crop prices in many of these countries (Bumb and Baanante, 1996). Fertilizer recommendations disregard variations in crop demand and soil properties and farmers' access to inputs and commodity markets with scales that are too large to capture soil heterogeneity (Smaling *et al*, 2002). Farmers on their part lack information about the best fertilizer to use for their particular fields and cropping practices, making the crop response to fertilizers more erratic and less profitable. Even within more localized recommendation domains, households operate at different stages of economic development leading to misuse and associated economic (Chase *et al*, 1991) and environmental risks (Bundy *et al.*, 2001).

The decline in the use of mineral fertilizer in Nigeria can be attributed to policy changes by the Government of Nigeria since 1988. CSIR - NARP (1998) identified privatization of the importation and distribution of fertilizers and the removal of subsidies as one of the causes of low fertilizer use. Obeng *et al.* (1990) also showed that economic response to fertilizer use by farmers varies with the type of farming

systems and level of fertilizer application. Fertilizer supply and availability at the right time also affects its usage. Moreover, the little fertilizer available is often not the correct type required for various crops and farmers are unfamiliar with its correct usage.

2.6 Biological Nitrogen Fixation in Legumes

Nitrogen, which occurs in the atmosphere and released through decomposition of organic material, is converted to ammonia by the process of BNF. This process is done through rhizobial fixation in legumes by free-living diazotrophs. Ammonia is further converted by oxidation or reduction to the forms $\text{NO}_3^- \text{N}$ and $\text{NH}_4^+ \text{N}$, respectively, which are available to plants (Zahran, 1999). The plant furnishes the necessary energy that enables the bacteria to fix gaseous N_2 from the atmosphere and pass it on to the plant for use in producing protein.

The first nodules form within one week after seedling emergence and become visible as they increase in size. Ten to fourteen days later, the nodule bacteria are able to supply most of the plant's nitrogen requirements. The nodules allow fixation of atmospheric nitrogen but are energetically expensive to develop and maintain (Shantharam and Mattoo, 1997). Hence the host suppresses the growth of most potential root nodules soon after the initial bacterial invasion of root hairs (Spaink, 1995). It also further regulates nodule number in response to environmental factors such as the presence of nitrate or other sources of fixed nitrogen in the soil (Vandyk, 2003). The nodules which are red or pink in colour are effective while the nodules that

are white in colour are ineffective, or have not yet developed to a stage at which they can fix nitrogen.

2.7 Factors affecting BNF

There are several environmental factors affecting BNF. The process of N fixation is strongly related to the physiological states of the host plant. Severe environmental conditions such as salinity, unfavourable soil pH, nutrient deficiency, mineral toxicity, extreme temperature conditions, low or extremely high levels of soil moisture, inadequate photosynthates, and disease conditions can affect plant growth and development (O'Hara *et al.*, 1988). The rate of BNF is highly variable and depends on bacterial strain, legume cultivar, soil, and environmental conditions (Shantharam and Mattoo, 1997). Moisture stress can adversely affect nodule functions. Drought conditions can reduce nodule weight and nitrogenase activity. After exposing to moisture stress for 10 days, the nodule cell wall starts to degrade resulting in senescence of bacteroids (Ramos *et al.*, 2003). Under saline conditions, the accumulation of Na⁺ reduces plant growth, nodule formation and symbiotic N fixation capacity (Soussi *et al.*, 1998; Kouas *et al.*, 2010). High salt level can affect the early interaction between the *rhizobium* and legumes in nodule formation (Singleton and Bohlool, 1984).

The plant nitrogenase activity reduces dramatically as a result of formation of ineffective nodules at high temperature (40 °C) (Hungria and Franco, 1993). Extreme soil pH can reduce rhizobial colonization in the legume rhizosphere. Nitrogen fixation can be inhibited by low soil pH (van Jaarsveld, 2002).

The characteristics of highly acidic soils ($\text{pH} < 4$) are low level of phosphorous, calcium and molybdenum along with aluminum and manganese toxicity, which affects both plant and the rhizobia. As a result of low soil pH conditions, nodulation and N fixation is severely affected than the plant growth (FAO, 1984).

Highly alkaline ($\text{pH} > 8$) soils tend to be high in sodium (Na^+), chloride (Cl^-), bicarbonate (HCO_3^-) and borate (BO_3^{3-}) which reduces N fixation (Bordereau and Prevost, 1994). Uddin *et al.* (2008) reported that nodule number and size were significantly inhibited by the application of N fertilizer (urea). Symbiotic N fixation varies according to the carbon allocation to the nodules, in relation to endogenous factors, current photosynthesis, crop growth rate and other competing sinks for carbon (Voisin *et al.*, 2003).

2.8 The need for inoculation in legume production

Although *rhizobia* are widely distributed in the soil, soils in different places contain different strains of *rhizobia* and some of which may not be effective for nitrogen fixation. Some soils may have effective rhizobial strains, but contains higher number of ineffective strains (Herridge *et al.*, 2002). In both cases, inoculation of the seed may be required. Inoculation of legume seed is a simple and practical means of ensuring effective nitrogen fixation in cases of manure deficiency.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Experimental site

The study was carried out in the Faculty of Agriculture Research and Experimental farm, University of Benin, Benin city. The area lies between Latitude 6°20' and 3.2"N and Longitude 50 36' 2.5' E, with annual rainfall range of 1825- 2025mm, height of 87mm above sea level and mean temperature of 27°C (Aneni and Aisagbonhi, 2015). The area lies within the tropical rainforest ecological zone, with a bimodal rainfall distribution pattern, with peak in July/August and September, and lower precipitation period in August known as "August Break" (Aneni and Aisagbonhi, 2015).

3.2 Cowpea varieties

Eleven (11) cowpea varieties were used in the experiment. Two (2) out of the Eleven (11) cowpea varieties were purchased from the open market in Benin city while the remaining Nine (9) was obtained from the Institute of Agricultural Research, Samaru, Zaira.

3.3 Experimental Design and Treatment

The Experimental design used for this study was the Randomized Complete Block Design (RCBD). The eleven cowpea varieties that served as treatment were replicated three times.

3.4 Sowing of seeds

The seeds were sowed directly into the soil with 5 seeds per stands at a depth of 1 - 2cm. There were later thinned to 2 seedlings per stand

3.5 Land Preparation

Prior to sowing, the land was cleared from debris.

3.6 Manure/fertilizer used

During the course of the experiment, no fertilizers were applied

3.7 Cultural practice

Weeding and watering were carried out as required.

3.8 Data collection

Measurement of growth variables began four weeks after sowing (4 WAS) up to ten weeks after sowing (10 WAS). Data were collected for growth variables such as plant height, leaf length, leaf area. Plant height, leaf length and breadth were measured using a meter rule. Leaf number was obtained by physical counting. Leaf area was determined using the nondestructive method (Saxena and Singh, 1965)

3.9 Data Analysis

Data obtained were subjected to analysis of variance using SAS software version 9.0 (2000). Means were separated using LSD at 5% level of significance.

CHAPTER FOUR

4.0

RESULTS

Effect of cowpea varieties on some growth variables

Table 1 shows the effect of cowpea variety of some growth variables. Among the variable measured, leaf width and leaf area differed significantly whereas all other variables were similar irrespective of cowpea varieties. S14 and S15 produced statistically similar leaf width. However, S14 was significantly better than all other cowpea varieties in leaf width except SI 5. On the lower end, S18 significantly narrowest leaf width among per cowpea varieties. The significantly widest leaf area was produced by S15 whereas SI 8 produced the significantly narrowed leaf area among the cowpea varieties

Table 4.1: Evaluation of some growth variables

Variety	Leaf width	Leaf area	Leaf length	Number of leaf per plant	Plant height
S6	6.23de	49.80bc	11.58	19.67	38.56
S7	6.78b	47.25de	10.16	16.67	33.78
S11	6.37cd	48.43cd	11.06	23.00	37.33
S14	6.98a	48.05cd	12.49	21.00	33.89
S15	6.94ab	54.15a	11.51	22.33	31.00
S16	5.73f	41.41gh	10.08	21.67	• 30.55
S17	6.41c	45.28ef	10.21	21.33	36.67
S18	5.07g -	38.19i	10.71	22.00 •	41.78
S19	6.52c	51.79b	11.62	22.00	39.34
L1	5.68f	41.35h	10.30	23.00	35.67
L2	6.18e	43.69fg	10.23	24.67	32.89
LSD	0.170	2.33			
Significant	**	**	ns	ns	ns

Means with the same letters in the same column are not significantly different at P=0.05

CHAPTER FIVE

5.0 DISCUSSION AND CONCLUSION

5.1 DISCUSSION

The good yield of LW recorded for SI4, is probably due to the soil and climate conditions in the region. Leaf area depends on number of leaves and leaf expansion in a plant. Leaf area is made up of the total green area of emerged leaves (Keating and Carbery, 1993). The difference between varieties might be due to the genetic make-up of the varieties and adaptation to the environment. These findings are in accordance with Muchow (2005) who reported cowpea varietal differences for leaf width. The higher performance in plant height for S18 is associated with the varietal behavior. In agreement with this, Peksen (2004) has reported a large variation in plant growth parameters among cowpea varieties.

Regards to Leaf Area, improved performance could be attributed to genotypic nature of these varieties. The suitability of the pH value, the textural class, and the other properties observed for the soils of the study in the open field. The climate conditions (Kunert *et al*, 2016) and fertility of the soil (Kyei-Boahen *et al.*, 2017) are among the factors influencing yield response of cowpea. Therefore, the variability in rainfall, and the relative difference in soil condition at the study sites could explain the difference in the yield variation among the cowpea varieties.

5.2 Conclusion

Samaru 14 did best in leaf width whereas Samaru 15 did best in leaf area compared to other varieties.

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