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GROWTH AND YIELD RESPONSE OF COWPEA (*Vigna umguiculata* (L.) Walp) TO SOIL APPLIED FERTILIZER, FOLIAR FERTILIZER AND THEIR COMBINED APPLICATION IN MAKURDI, BENUE STATE, NIGERIA.

T. Iorlamen
Department of Crop Production, Joseph Sarwuan Tarka, University Makurdi, Nigeria.

C. A. Iorkyaa and
Department of Plant Breeding and Seed Science, Joseph Sarwuan Tarka, University, Makurdi, Nigeria.

R. O. Edoh
Department of Crop Production, Joseph Sarwuan Tarka, University Makurdi, Nigeria.

Correspondence: teryimaiorlamen@yahoo.com

Abstract
This study was conducted at the Teaching and Research Farm Joseph Sarwuan Tarka University, Makurdi located on Latitude 07.41°N, Longitude 08.39° E, and Altitude 106.4m above sea level. The experiment was a 2x4 factorial arranged in split plot design with three replications. The main factor was cowpea variety and the sub factor was frequency of liquid fertilizer application. Treatment combinations were made up of two cowpea varieties (SAMPEA 15 and FUAMPEA 2), SSP and three (3) foliar fertilizer spraying regimes. Analysis of variance for growth parameters of cowpea varieties indicated a highly significant difference for days to first flowering, days to 50% flowering and days to 95% maturity while no significant differences was observed for plant height at flowering, number of branches per plant and plant biomass in respect to variety. Significant difference was observed for plant height at flowering while no significant difference was observed for days to first flowering, days to 50% flowering, days to 95% maturity, number of branches per plant and plant biomass in respect to fertilizer levels. Result on the interaction between Variety and Fertilizer application indicates no significant difference for all the growth parameters measured. Analysis of variance for yield and yield parameters of Cowpea varieties shows significant difference for number of pods per peduncle while no significant differences were observed for peduncle per plant, number of pods per plant, seed per pod, 100seed weight, pod weight kg/ha and seed weight kg/ha. Result for fertilizer levels indicated significant difference at 1% level of probability for peduncle per plant, number pods per plant and 100 seed weight. Also a significant difference at 5% was observed for seed weight kg/ha. While no significant differences were observed for pods per peduncle, seeds per pod and pod weight kg/ha. Result on the interaction between Variety and Fertilizer application indicated highly significant differences for peduncle per plant and number of pods per plant. No significant differences were observed for pods per peduncle, seed per pod, 100 seed weight, pod weight kg/ha and seed weight kg/ha. It can be concluded that variety FUAMPEA 2 had a consistent performance over SAMPEA 15 with regards to yield and yield parameters. The various fertilizer levels played an important role in magnifying various characters measured. Three (3) liters of Agriboom foliar fertilizer (3 spray) had the least days to flowering and days to 95% maturity, while 200kg/ha SSP had the highest seed weight kg/ha. The best combination with regards to seed weight kg/ha (1580kg) and days to 95% maturity was gotten from SAMPEA 15×200kg/ha SSP. In terms of earliness to flowering, SAMPEA 15×3 liters of Agriboom foliar fertilizer (3 spray). It can therefore be recommended that for optimum yield, the variety SAMPEA 15 in combination with 200kg/ha SSP should be planted. Also SAMPEA 15 in combination with 3 liters of Agriboom foliar fertilizer (3 spray) can be adopted for earliness to maturity, pod weight kg/ha and seed weight, had a strong correlation and thus could be listed in selection criteria for good parental lines in a cowpea breeding program.

Keywords: Cowpea, foliar fertilizer, spray regime, correlation.

Introduction

Legumes are considered the most important source of food after cereals in the world, as they are main sources of protein and energy for human. Currently, it can be a good alternative for animal protein. Due to nutrition values and economic importance, it is necessary to develop new methods for increasing the crop production. Using foliar fertilization including micronutrients is one of these new methods that are considered more effective on yield, protein content and nitrogen fixation in pulses. In addition, cowpea is the most important crop of legume family that can be planted in semiarid region. In this area, the plant produces seeds containing18-32 % protein; as well as, nitrogen fixation ability. Therefore, it plays important role in human nutrition and sustainable farming systems (Hemmati, 2005).

Macronutrients such as NPK affect plant growth and development, they are depending on micronutrients availability. (Salwa *et al.,* 2011) stated that microelements are crucial substances for crop's growth; however, they are used in lower amounts compared to macronutrients, such as N, P and K. They have a major role in cell division and development of meristematic tissues, photosynthesis, respiration and acceleration of plant maturity (Zeidan *et al*., 2010). In addition, iron (Fe), boron (B), zinc (Zn), copper (Cu), and manganese (Mn) are considered essential micronutrients for plants and humans (Asad and Rafique, 2000; Hao *et al*., 2007); and micronutrients can maintain crop-physiology balance. Furthermore, these elements play vital roles in CO_2 flowing out, vitamin A improvement and resistant system activities (Narimani *et al*., 2010). So, deficiency of these nutrients can markedly reduce crop's yield, and even can cause ceasing plant growth. Mostly, amounts of iron, boron and zinc in soil are more than the plant needs but cannot readily be absorbed by plants. Thus, it is better to use foliar application, as it is more effective than adding fertilizer to soil. However, root is common to be first part of plant that adsorbs nutrients from soils, but nutrients availability might be restricted, then affects fertilizer efficiency. So, it is better to recommend foliar application that provides nutrients for plant (Altındişl *et al.,* 1998).

Foliar fertilization or feeding refers to the application of fertilizers to the crops in the form of spray through the leaves. The introduction of foliar fertilizers is not to replace the well-known soil fertilizer placement method, but rather to aid to the root supply (Asad and Rafique, 2000). In fact, foliar fertilization is applied in small droplets on the leaves and stems of the plant; then nutrients are absorbed through these parts of plants (Kuepper, 2003). Also, foliar application can supply the nutrients for plants rapidly to obtain high performance guarantee. From an ecological perspective, foliar fertilization is more acceptable, because the small amounts of nutrients are used for rapid use by plants (Stampar *et al.,* 1998). On the other hand, legume seeds provide an exceptionally varied nutrient profile including proteins, fibers, vitamins, minerals, and proteins are considered major components of legume seeds (Mitchell *et al.* 2009).

Nitrogen that is used by seedling during germination is stored in seeds in the form of proteins. Seeds contain from 16% to 50% protein and provide one third of all dietary protein nitrogen (Graham and Vance, 2003). Of course, improving the protein content of grain legume seeds depend on genetic variability, environmental variability and heritability. The present study investigates the effect of foliar fertilizers spraying regime on the growth and yield of cowpea to ascertain the most viable and cost effective alternative for a profitable and sustainable cowpea production in Makurdi.

Materials and Methods

The experiment was conducted at Teaching and Research Farm of the University of Agriculture, Makurdi (Latitude 7.41^0N & Longitude 8.39^0E at an elevation of 97m above sea level). This location falls within

the Southern Guinea Savannah Agro-ecological zone of Nigeria.

The experimental farm was cleared manually using a cutlass while ridges were made using a hoe. Planting was done on the 18th August, 2018. The plot size was $15m^2$ and was planted at a spacing of 0.75m x 0.25m at the rate of 3 seeds per hill and later thinned to 2 plants per hill at 2 weeks after sowing. The experiment was a 2x4 factorial arranged in split plot design with three replications. The main factor was cowpea variety and the sub factor was frequency of liquid fertilizer application. Treatment combinations were made up of two cowpea varieties (SAMPEA 15 and FUAMPEA 2) and three foliar fertilizer (Agriboom) spraying regimes compared with recommended SSP fertilizer of 200kg/ha. The treatment combinations were as follows:

VARIETY	SPRAY REGIME
SAMPEA 15	100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 Spray)
SAMPEA 15	**100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray)**
SAMPEA 15	3 liters of Agriboom foliar fertilizer (3 Spray)
SAMPEA 15	**200kg/ha SSP**
FUAMPEA 2	100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 spray)
FUAMPEA 2	**100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray)**
FUAMPEA 2	3 liters of Agriboom foliar fertilizer (3 spray)
FUAMPEA 2	**200kg/ha SSP**

The cowpea varieties used in the study were obtained at the Molecular Biology Laboratory, Joseph Sarwuan Tarka University, Makurdi. The spraying regime or frequency was at every 2 weeks' interval from 14 days after sowing. Pre-emergence herbicide was applied within 24 hours after sowing and later hand weeding was done at 4 weeks after sowing to keep the field weed free. Observations were recorded on the following parameters: **Plant Height at 21 DAS (cm);** Average plant height in centimeter (cm) from 5 randomly selected plants in each plot at 21 days after sowing. **Plant Height at 35 DAS (cm),** Average plant height in centimeter (cm) from 5 randomly selected plants in each plot at 35 days after sowing. **Days to First Flowering;** Number of days from sowing to when the first flower opens in a plot. **Days to Fifty Percent (50%) Flowering;** Number of days from sowing to when half of plants in the plots flowers. **Days to Ninety-five Percent (95%) Maturity;** Number of days from sowing to when the day 95% pods are dried in the field. Number of peduncle **per plant,** Average number of peduncle from 5 plants in each plot at the time of harvest. **Pods per Peduncle;** Average number of pods per peduncle from 5 plants in each plot at the time of harvest. **Branches per plant;** Number of branches per plant was obtained as mean number of branches of the randomly selected plants per plot at the time of harvest. **Pod per plant;** Five plants were randomly sampled at harvest and the number of pods per plant was counted and the average obtained. **Seed per Pod,** Average

number of seeds from 10 pods in each plot at the time of harvest. **100-seed weight (g);** Weight of hundred seeds in grams (g) was recorded per plot. **Pod weight per plot (kg/ha);** Weight of grain in kg/ha of each plot was recorded at the time of harvest. **Seed Weight kg/ha;** Weight of grain in kg/ha of each plot was recorded at the time of harvest. **Plant Biomass kg per ha;** Weight of total dry fodder in each plot in kg Analysis of variance for growth components of Cowpea varieties is presented in Table 1. Result indicated a highly significant difference for days to first flowering, days to 50% flowering and days to 95% maturity while no significant differences was observed for plant height at 21, 35 days after sowing, number of branches per plant and plant biomass in respect to variety. Significant difference was observed for plant height at 35 days after sowing (DAS) while no significant difference was observed Analysis of variance for yield and yield components of Cowpea varieties is presented in Table 2. Result for variety shows significant difference for number of pods per peduncle while no significant differences were observed for peduncle per plant, number of pods per plant, seed per pod, 100seed weight, pod weight kg/ha and seed weight kg/ha. Result for fertilizer levels indicated significant difference at 1% level of probability for peduncle per plant, number pods per plant and 100 seed weight. Also a significant difference at 5% was observed for seed weight kg/ha. While no Main effect of fertilizer levels on Cowpea Varieties is presented in Table 3. Result revealed that 200kg/ha SSP. had shorter plants for plant height at 21 and 35 DAS (9.12 and 19.17) respectively while, 3 liters of Agriboom foliar fertilizer (3 spray) had taller plants at 21 DAS (9.73) and 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray) (26.67) at 35 days after sowing. Result on days to first flowering reveal that 200kg/ha SSP and 100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 spray) were statistically the same and had the least and converted to kg per ha. Data collected was subjected to Analysis of Variance (ANOVA) using Mini Tab. Version 2017. Treatment means were separated and ranked using Fisher-least significant difference (F-LSD) at 0.01 and 0.05% level of probability.

Results

Mean Squares from the Analysis of variance (ANOVA) on Growth of Cowpea for plant height at 21 days after sowing, days to first flowering, days to 50% flowering, days to 95% maturity, number of branches per plant and plant biomass in respect to fertilizer levels. Result on the interaction between Variety and Fertilizer application indicates no significant difference for all the growth parameters measured.

Mean Squares from the Analysis of variance (ANOVA) on Yield and yield components of Cowpea

significant differences were observed for pods per peduncle, seeds per pod and pod weight kg/ha. Result on the interaction between Variety and Fertilizer application indicated highly significant differences for peduncle per plant and number of pods per plant. No significant differences were observed for pods per peduncle, seed per pod, 100 seed weight, pod weight kg/ha and seed weight kg/ha.

Main effects of spraying regime over control SSP on Growth Components of Cowpea Varieties

number of days to flowering (44.67) while highest number of days to first flowering was recorded by 3 liters of Agriboom foliar fertilizer (3 spray) (43.83). 3 liters of Agriboom foliar fertilizer (3 spray) had highest number of days to 50% flowering (49.5) while least number of days to 50% flowering was recorded by 100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 spray) (47.83). Higher number of days to 95% maturity was recorded by 200kg/ha SSP (71.17) while 3 liters of Agriboom foliar fertilizer (3 spray) was earliest (69.83). 3

liters of Agriboom foliar fertilizer (3 spray) and 200kg/ha SSP were statistically the same and recorded the highest number of branches per plant (3.1) while the least was recorded by 100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 spray) (2.8). 100kg/ha SSP + 1 liter of Agriboom foliar Main effect of fertilizer levels on yield and yield components of cowpea varieties is presented in Table 4. Result revealed 200kg/ha SSP had the highest peduncle per plant (14.6) while the least was recorded by 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray) (2.4) Table 4. Three (3) liters of Agriboom foliar fertilizer (3 spray) had the highest number of pods per plant (2.75) while the lowest was recorded by 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray) (2.4). 200kg/ha SSP had the highest number of pods per plant (17.67) while the least was recorded for 100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 spray) (7.000).

Highest number of seed per pod was recorded by 200kg/ha SSP (9.6) while least seed per pod was recorded by 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray) (10.97). Result on 100 Seed weight reveals that 200kg/ha SSP weighed higher (19.23) while 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray) had the least weight (15.58) Table 4. Result on Pod weight kg per ha reveal that 200kg/ha SSP had the highest weight (1529.28) while least pod weight was recorded by 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray) (1218.25). 200kg/ha SSP weighed higher (1299.89) while 100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 spray) weighed less (695.31).

Main effect of Cowpea varieties on growth components

Main effect of Cowpea varieties on growth components is presented in Table 5. Result revealed that the variety FUAMPEA 2 was comparatively higher than SAMPEA 15 for the following character measured plant height at 35 DAS (24.00), days to 50% flowering (50.42), days to 95% maturity (73.33), number of branches per plant (3.02) and plant biomass kg/ha (2527.78) meanwhile, SAMPEA 15 had taller plants at 21 DAS (9.66) as well had higher number of days to first flowering (46.67) as compare to FUAMPEA 2.

Main effect of Cowpea varieties on yield and yield components

Main effect of Cowpea varieties on yield and yield components is presented in Table 6. Result revealed that the variety FUAMPEA 2 was comparatively higher than SAMPEA 15 for the following character measured peduncle per plant (11.16), number of pods per plant (3.02), number of pods per plant (11.95), number of seeds per pod (10.65), 100 seed weight (17.59), pods weight kg/ha (1484.94), and seed weight kg/ha (10780.00) Table 6.

Main effects of the interaction between variety and spraying regime levels

Main effects of the interaction between Variety and Fertilizer levels are presented in Table 7. Result revealed that SAMPEA 15× 100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 spray) (10.13) had taller plants at 21 DAS, while shorter plants were recorded by SAMPEA 15×SSP rec (8.77). FUAMPEA 2× 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray) had taller plants (30.67) while FUAMPEA 2×200kg/ha SSP had shorter plants (18.73) with regards to plant height at 35 DAS. FUAMPEA 2×200kg/ha SSP had higher number of days to first flowering (47.67) while least number of days to first flowering was recorded by SAMPEA 15×3 liters of Agriboom foliar fertilizer (3 spray) (41.33). Higher number of days to 50% flowering

was recorded by FUAMPEA 2×3 liters of Agriboom foliar fertilizer (3 spray) (52.00), while SAMPEA 15×200kg/ha SSP was earlier (46.00). Higher number of days to 95% maturity was recorded by FUAMPEA 2× 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray) (73.33) while least was recorded by SAMPEA 15×200kg/ha SSP (67.00). The interactive effect of SAMPEA 15×3 liters of Agriboom foliar fertilizer (3 spray) gave the highest number of branches per plant (3.40) while least branches was realized by SAMPEA 15× 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray) (2.53). Results on plant biomass revealed SAMPEA 15× 100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 Spray) had higher biomass (33888.89) while SAMPEA 15× 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray) had the least biomass (1666.67).

Main effects of the interaction between variety and spraying regime levels

Main effects of the interaction between Variety and Fertilizer levels are presented in Table 8. Result revealed higher peduncle per plant was recorded by SAMPEA 15×200kg/ha SSP (15.90) while least was recorded by FUAMPEA 2× 100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 spray) (8.50). SAMPEA 15×200kg/ha SSP had higher pods per peduncle (3.33) while least was recorded by FUAMPEA 2× 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray) (1.80). FUAMPEA 2×200kg/ha SSP gave higher number of pods per plant (17.80) while least pods per plant was recorded by SAMPEA 15× 100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 spray) (6.67).

FUAMPEA 2× 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray) had the highest number of seeds per plant (11.47) while least number of seeds per plant was recorded by FUAMPEA 2×200kg/ha SSP (9.00). Result on 100 seed weight revealed that FUAMPEA 2×200kg/ha SSP weighed higher (19.27) while least weight was recorded by SAMPEA 15× 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray) (14.10). Result on Pod weight kg per ha reveal that SAMPEA 15×200kg/ha SSP weighed higher (1859.22) while SAMPEA 15× 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray) had the least weight (253.72). SAMPEA 15×200kg/ha SSP weighed higher (1580.34) with regards to seed weight kg/ha while FUAMPEA 2× 100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 spray) had the least weight (680.87)

Pearson's correlation coefficient of cowpea

Pearson correlation coefficient of Cowpea is presented in Table 9. Result revealed plant height at 21 DAS was negative but significantly correlated with plant height at 35 DAS (-0.40). Positive and significant correlation was observed between plant height at 35 DAS and number of seed per plant (0.52) while negative and significant correlation was observed between plant height at 35DAS and Peduncle per plant (-0.60), number of pods per plant (-0.48).

Positive/negative and significant correlation was observed between the following pairs; days to first flowering and days 50% flowering (0.67), days to first flowering and days 95% maturity (0.51), days to first flowering and number of pods per plant (-0.46), days to first flowering and pod weight kg/ha (-0.43), days to 50% flowering and days to 95% maturity (0.57), days to 50% flowering and number of pods per plant (-0.64), days to 95% maturity and number of pods per plant (-0.60), peduncle per plant and number of pods per plant (0.86), peduncle per plant and pod weight kg/ha (0.44), peduncle per plant and seed weight kg/ha (0.63), number of pods per plant and seed weight kg/ha (0.61), 100 seed weight kg/ha and plant biomass kg/ha (0.48), pod weight kg/ha and seed weight kg/ha (0.93).

Discussion

Result on plant height at 21 and 35 days after sowing revealed that a non-significant difference amongst the varieties studied however, Magani and Kuchinda, (2009) reported that the differences in plant height could be attributed to genetic effect of individual varieties. Number of days to 50% flowering indicated that SAMPEA 15 was earlier than FUAMPEA 2 this result is similar to the findings of Cobbinah *et al*. (2011) who reported that 98.9% of the accessions evaluated took between 31-49 days after planting to attain 50% flowering.

Result on frequency of spray (100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 spray) reduced the number of days to 50% flowering; similar result was obtained by Karikari *et al.* (2015) who reported Phosphorus fertilizer application reduced days to 50% flowering significantly. Seed yield is governed by number of factors, which have a direct or indirect impact. Among them are yield components such as number of pods per plant, number of seeds per pod and 100-seed weight over a given land area (Ayodele and Oso, 2014). A good seed yield will require varieties with short flowering periods to enable them divert energy into pod and seed development. Nkaa *et al*. (2014) stated that the earlier a variety sets flowers, the earlier it matured, One of the important yield component in cowpea is100-seed weight, results on 100 seed weight showed that FUAMPEA2×200kg/ha SSP weighed highest also number of pods per plant was significantly different meaning that the frequency of spray had effect on the podding of the various cowpea varieties, this compares favourably with reports by other researchers (Haruna and Usman, 2013; Ndor *et al*., 2012; Singh *et al*., 2011), who also discovered significant increase in pod number of cowpea in response to phosphorus application.

Correlation shows nature and extent of such association between any two characters, a positive correlation between desirable characters is favorable to the plant breeder because it helps in simultaneous improvement of both the characters. A negative correlation will hinder the simultaneous expression of both the characters with high values; Pod weight kg/ha had a positive and significant correlation with seed weight. Kalambe *et al.* (2019) reported positive correlation between number of pods per plant and pod weight however, there was no significant difference observed between number of pods per plant and pod weight from the study.

Conclusion and Recommendations

It can be concluded that variety FUAMPEA 2 had a consistent performance over SAMPEA 15 with regards to yield and yield components. The various fertilizer levels played an important role in magnifying various characters measured, 3 liters of Agriboom foliar fertilizer (3 spray) had the least days to flowering and days to 95% maturity, while 200kg/ha SSP had the highest seed weight kg/ha. The best combination with regards to seed weight kg/ha and days to 95% maturity was gotten from SAMPEA 15×200kg/ha SSP. In terms of earliness to flowering, SAMPEA 15×3 liters of Agriboom foliar fertilizer (3 spray). It can therefore be recommended that for optimum yield the variety SAMPEA 15 in combination with 200kg/ha SSP should be planted, also SAMPEA 15 in combination with 3 liters of Agriboom foliar fertilizer (3 spray) can be adopted for earliness to maturity, pod weight kg/ha and seed weight, had a strong correlation and thus could be listed in selection criteria for good parental lines in a cowpea breeding program.

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Table 1: Mean Squares from the Analysis of variance (ANOVA) for Growth Components of Cowpea

SOV	Df	PH21 DAS	PH35 DAS	DFF	D50%F	D95%M	BPP	PBkg/ha
Variety	1	0.67ns	35.53ns	73.5**	77.04**	204.17**	0.08ns	56715.23ns
Fertilizer levels	3	0.42ns	56.48*	0.94ns	4.15ns	1.83ns	0.16ns	1513498.9ns
Variety × Fertilizer	3	0.86ns	22.41ns	10.5ns	4.71ns	5.61ns	0.42ns	837575.66ns
S.E	14	0.46	12.34	6.46	2.52ns	4.66	0.58	763719.48
CV		7.17	15.42	5.72	3.26	3.07	25.65	35.25

Key: PH21 DAS: Plant Height at 21 DAS, PH35 DAS: Plant Height at 35 DAS, DFF: Days to first flower, D50%F: Days to 50% Flower, D95%M: Days to 95% pod Maturity, BPP: Number of branches per plant and PBkg/ha: Plant Biomass (kg/ha).

Table 2: Mean Squares from the Analysis of variance (ANOVA) for Yield and yield components of Cowpea

SOV	Df	PePP	PPP	NPP	SPP	100SWT	PWTkg/ha	SWTkg/ha
Variety	1	3.92ns	5.13*	0.19ns	1.60ns	0.25ns	315186.67ns	205087.38ns
Fertilizer levels	3	55.21**	0.14ns	133.32**	1.97ns	13.42**	139053.76ns	428565.11*
Variety× Fertilizer	3	6.43**	0.24ns	11.73**	1.98ns	5.74ns	125464.14ns	95604.01ns
S.E	14	0.91	0.61	0.48	1.57	2.27	133092.2	89310.97
CV		8.88	29.90	5.86	12.04	8.61	26.62	30.26

KEY: PePP: Number of peduncle per plant, PPP: Pods per Peduncle, NPP: number of pods per plant, SPP: Number of Seeds per pod, 100SWT: 100 Seed weight (g), PWTkg/ha: Pod weight kg per ha and SWTkg/ha: Seed weight kg per ha, PBkg/ha: Plant Biomass (kg/ha).

Table 3: Effects of Fertilizer levels on Growth of Cowpea in Makurdi

Fert. Levels	PH21 DAS	PH35 DAS	DFF	D50%F	D95%M	BPP	PBkg/ha
100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 spray)	9.58	22.5	44.67	47.83	70.33	2.8	2861.11
100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray)	**9.58**	**26.67**	**44.5**	**49.17**	**70.33**	**2.83**	**2750**
3 liters of Agriboom foliar fertilizer (3 spray)	9.73	22.8	43.83	49.5	69.83	3.1	2555.56
200kg/ha SSP	**9.12**	**19.17**	**44.67**	**48.00**	**71.17**	**3.1**	**1750.00**
LSD.05	**0.84**	**4.35**	**3.15**	**1.96**	**2.67**	**0.93**	**1082.16**

KEY: PH21 DAS: Plant Height at 21 DAS, PH35 DAS: Plant Height at 35 DAS, DFF: Days to first flower, D50%F: Days to 50% Flower, D95%M: Days to 95% pod Maturity, BPP: Number of branches per plant and PBkg/ha: Plant Biomass (kg/ha).

Table 4: Effect of Fertilizer on Yield and Yield Components of Cowpea in Makurdi

Fert. Levels	PePP	PPP	NPP	SPP	100SWT	PWTkg/ha	SWTkg/ha
100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 spray)	8.95	2.67	7.00	10.45	17.47	1264.19	695.31
100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray)	**7.8**	**2.4**	**9.3**	**10.97**	**15.58**	**1218.25**	**852.77**
3 liters of Agriboom foliar fertilizer (3 spray)	11.67	2.75	13.52	10.55	17.68	1469.67	1102.25
200kg/ha SSP	**14.6**	**2.67**	**17.67**	**9.6**	**19.23**	**1529.28**	**1299.89**
LSD.05	**1.18**	**0.97**	**0.86**	**1.55**	**1.86**	**451.75**	**370.06**

KEY: PePP: Number of peduncle per plant, PPP: Pods per Peduncle, NPP: number of pods per plant, SPP: Number of Seeds per pod, 100SWT: 100 Seed weight (g), PWTkg/ha: Pod weight kg per ha and SWTkg/ha: Seed weight kg per ha, PBkg/ha: Plant Biomass (kg/ha)

Table 5: Effect of Variety on Growth of Cowpea in Makurdi

Variety	PH21 DAS	PH35 DAS	DFF	D50%F	D95%M	BPP	PBkg/ha
FUAMPEA 2	9.33	24.00	46.17	50.42	73.33	3.02	2527.78
SAMPEA 15	**9.66**	**21.57**	**46.67**	**46.83**	**67.5**	**2.9**	**2430.56**
$LSD_{.05}$	**1.00**	**3.08**	**2.23**	**1.39**	**1.89**	**0.66**	**765.20**

KEY: PH21 DAS: Plant Height at 21 DAS, PH35 DAS: Plant Height at 35 DAS, DFF: Days to first flower, D50%F: Days to 50% Flower, D95%M: Days to 95% pod Maturity, BPP: Number of branches per plant and PBkg/ha: Plant Biomass (kg/ha).

Table 6: Effect of Variety on Growth of Cowpea in Makurdi

Variety	PePP	PPP	NPP	SPP	100SWT	PWTkg/ha	SWTkg/ha
FUAMPEA 2	11.16	3.08	11.95	10.65	17.59	1484.94	10780.00
SAMPEA 15	**10.35**	**2.16**	**11.79**	**10.13**	**17.39**	**1255.75**	**895.11**
$LSD_{.05}$	**0.84**	**0.67**	**0.61**	**1.10**	**1.32**	**319.44**	**261.67**

Key: PePP: Number of peduncle per plant, PPP: Pods per Peduncle, NPP: number of pods per plant, SPP: Number of Seeds per pod, 100SWT: 100 Seed weight (g), PWTkg/ha: Pod weight kg per ha and SWTkg/ha: Seed weight kg per ha, PBkg/ha: Plant Biomass (kg/ha)

Table 7: Interaction Effects between Variety and Fertilizer levels on Growth of Cowpea in Makurdi.

Var. × Fert. Levels	PH21 DAS	PH35 DAS	DFF	D50%F	D95%M	BPP	PBkg/ha
FUAMPEA 2× 100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 spray)	9.03ab	22.93b	44.67abc	48.33bc	73.00a	3.00a	2333.33a
FUAMPEA 2× 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray)	9.23ab	30.67a	46.00abc	51.33a	73.33a	3.13a	1833.33a
FUAMPEA 2×3 liters of Agriboom foliar fertilizer (3 spray)	9.57ab	23.67b	46.33ab	52.00a	71.67ab	2.80a	2444.44a
FUAMPEA 2×200kg/ha SSP	9.47ab	18.73b	47.67a	50.00ab	75.33a	3.13a	3111.11a
SAMPEA 15× 100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 spray)	10.13a	22.07b	44.67abc	47.33bc	67.67c	2.60a	3388.89a
SAMPEA 15× 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray)	9.83ab	22.67b	43.00abc	47.00c	67.33c	2.53a	1666.67a
SAMPEA 15×3 liters of Agroboom foliar fertilizer (3 spray)	9.90ab	21.93b	41.33c	47.00c	68.00bc	3.40a	2666.67a
SAMPEA 15×200kg/ha SSP	8.77b	19.60b	41.67bc	46.00c	67.00c	3.07a	2388.89a
Cv	**7.17**	**15.42**	**5.72**	**3.26**	**3.07**	**25.65**	**35.25**

KEY: PH21 DAS: Plant Height at 21 DAS, PH35 DAS: Plant Height at 35 DAS, DFF: Days to first flower, D50%F: Days to 50% Flower, D95%M: Days to 95% pod Maturity, BPP: Number of branches per plant and PBkg/ha: Plant Biomass (kg/ha).

Table 8: Interaction Effects between Variety and Fertilizer levels on Yield and yield Components of Cowpea in Makurdi.

Var. × Fert. Levels	PePP	PPP	NPP	SPP	100SWT	PWTkg/ha	SWTkg/ha
FUAMPEA 2× 100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 spray)	8.50d	2.33a	7.33d	10.97a	17.13a	1237.94a	680.87b
FUAMPEA 2× 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray)	**9.10d**	**1.80a**	**7.53d**	**11.47a**	**17.07a**	**1182.78a**	**827.94b**
FUAMPEA 2×3 liters of Agriboom foliar fertilizer (3 spray)	11.13c	2.50a	15.15b	11.17a	16.90a	1402.94a	1052.21ab
FUAMPEA 2×200kg/ha SSP	**13.30b**	**2.00a**	**17.80a**	**9.00a**	**19.27a**	**1199.33a**	**1019.43ab**
SAMPEA 15× 100kg/ha SSP + 1 liter of Agriboom foliar fertilizer (1 spray)	8.50d	3.00a	6.67d	9.93a	17.80a	1290.44a	709.74b
SAMPEA 15× 100kg/ha SSP + 2 liter of Agriboom foliar fertilizer (2 spray)	**9.10d**	**3.00a**	**11.07c**	**10.47a**	**14.10b**	**253.72a**	**877.61b**
SAMPEA 15×3 liters of Agriboom foliar fertilizer (3 spray)	9.40d	3.00a	11.90c	9.93a	18.45a	1536.39a	1152.29ab
SAMPEA 15×200kg/ha SSP	**15.90a**	**3.33a**	**17.53a**	**10.20a**	**19.20a**	**1859.22a**	**1580.34a**
Cv	**8.88**	**29.90**	**5.86**	**12.04**	**8.61**	**26.62**	**30.26**

KEY: PePP: Number of peduncle per plant, PPP: Pods per Peduncle, NPP: number of pods per plant, SPP: Number of Seeds per pod, 100SWT: 100 Seed weight (g), PWTkg/ha: Pod weight kg per ha and SWTkg/ha: Seed weight kg per ha, PBkg/ha: Plant Biomass (kg/ha)

Table 9: Correlation Co-efficient of Growth and Yields Parameters in Cowpea

	PH21 DAS	PH35 DAS	DFF	D50%F	D95%M	PePP	PPP	BPP	NPP	SPP	100SWT	PWTkg/ha	SWTkg/ha	PBkg/ha
PH21 DAS	1	-0.41*	-0.00ns	-0.09ns	-0.14ns	-0.15ns	0.12ns	-0.07ns	-0.12	-0.24ns	-0.28ns	-0.30ns	-0.34ns	0.38
PH35 DAS		1	10.12ns	0.40ns	0.08ns	-0.60**	-0.38ns	0.04ns	-0.48*	0.52**	-0.22ns	-0.27ns	-0.31ns	-0.35ns
DFF			1	0.67**	0.51*	-0.13ns	-0.46*	0.21ns	0.04ns	0.28ns	0.24ns	-0.43*	-0.36ns	0.24ns
D50%F				1	0.57**	-0.28ns	-0.64**	-0.06ns	0.05ns	0.36ns	0.15ns	-0.27ns	-0.18	0.01ns
D95%M					1	-0.10ns	-0.60**	0.10ns	0.08ns	-0.04ns	0.17ns	-0.20ns	-0.13ns	0.02ns
PePP						1	0.22ns	0.17ns	0.86**	-030ns	0.35ns	0.44*	0.63**	0.11ns
PPP							1	-0.28ns	0.07ns	0.00ns	-0.15ns	0.36ns	0.29ns	-0.02ns
BPP								1	0.08ns	-0.09ns	0.38ns	-0.09ns	-0.00ns	0.25ns
NPP									1	-0.25ns	0.33ns	0.32ns	0.61**	0.09ns
SPP										1	-0.12ns	-0.05ns	-0.11ns	-0.32ns
100SWT											1	0.29ns	0.37ns	0.48*
PWTkg/ha												1	0.93**	-0.11ns
SWTkg/ha													1	-0.12ns
PBkg/ha														1