NUTRIENT UPTAKE AND COWPEA PERFORMANCE FOLLOWING EARLY SEASON MAIZE CULTIVATION UNDER DIFFERENT FERTILIZER TYPES †

[ABSORCIÓN DE NUTRIENTES Y RENDIMIENTO DEL CAUPÍ DESPUÉS DEL CULTIVO DE MAÍZ DE PRINCIPIOS DE TEMPORADA BAJO DIFERENTES TIPOS DE FERTILIZANTES]

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SUMMARY

Background. The complementary application of organic and inorganic fertilizers has been found to meet soil nutrient deficits, enhance soil physical properties and crop yield. **Objective.** To evaluate the residual effect of initial application of different fertilizer types on cowpea performance and nutrient uptake. **Methodology.** A field trial was carried out in the late season between September-November, 2015. Initial fertilizer treatments consisted of poultry manure at 5 t ha^{-1} + urea (100 kg ha^{-1}), cow dung at 5 t ha^{-1} + urea (100 kg ha^{-1}), Oyo organic (also known as pace setter fertilizer made in Oyo state, Nigeria) at 5 t ha^{-1} + urea (100 kg ha^{-1}) and control (No fertilizer application). Three cowpea varieties (Ife brown, Modupe and Ife 98-12) were evaluated on residual plots. Treatments were evaluated in Randomized Complete Block Design (RCBD)(r=4). Data were collected on growth, yield, chlorophyll content as well as post- planting soil nutrient compositions. **Results.** All the parameters of the cowpea varieties were better performed on residual plots of poultry manure (5 t ha^{-1}) augmented with urea (100 kg ha^{-1}) for the soil nutrient status, plant uptake and crop yield. Similarly, plant grown on soil previously amended with poultry manure + urea had significant higher chlorophyll contents. Highest grain yield of 4.45 t ha^{-1} was obtained in the residual plots of poultry manure + urea. **Conclusion.** Application of poultry manure (5 t ha^{-1}) together with urea (100 kg ha^{-1}) had significant effect on optimum yield of cowpea

Keyword: Chlorophyll; Dry matter accumulation; Yield; Cowpea varieties.

RESUMEN

Antecedentes. Se ha encontrado que la aplicación complementaria de fertilizantes orgánicos e inorgánicos satisface los déficits de nutrientes del suelo, mejora las propiedades físicas del suelo y el rendimiento del cultivo. **Objetivo.** Evaluar el efecto residual de la aplicación inicial de diferentes tipos de fertilizantes sobre el rendimiento del caupí y la absorción de nutrientes. **Metodología.** Se llevó a cabo una prueba de campo a fines de la temporada entre septiembre y noviembre de 2015. Los tratamientos iniciales de fertilización consistieron en estiércol de aves de corral a 5 t ha^{-1} + urea (100 kg ha^{-1}), estiércol de vaca a 5 t ha^{-1} + urea (100 kg ha^{-1}), Oyo orgánico (también conocido como fertilizante marcapasos hecho en el estado Oyo, Nigeria) a 5 t ha^{-1} + urea (100 kg ha^{-1}) y control (sin aplicación de fertilizante). Se evaluaron tres variedades de caupí (Ife brown, Modupe e Ife 98-12) en parcelas residuales. Los tratamientos se evaluaron en el diseño de bloques completos al azar (RCBD) (r = 4). Se recolectaron datos sobre el crecimiento, el rendimiento, el contenido de clorofila, así como las composiciones de nutrientes del suelo posteriores a la siembra. **Resultados.** Todos los parámetros de las variedades de caupí fueron mejores en parcelas residuales con estiércol de aves de corral (5 t ha^{-1}) aumentadas con urea (100 kg ha^{-1}) para el estado de nutrientes del suelo, la absorción de las plantas y el rendimiento de los cultivos. De manera similar, las plantas cultivadas en el suelo previamente enmendado con estiércol de aves + urea tuvieron un contenido significativamente mayor de clorofila. El mayor rendimiento de grano de 4.45 t ha^{-1} se obtuvo en las parcelas residuales de estiércol de aves + urea. **Conclusión.** La aplicación de estiércol de aves de corral (5 t ha^{-1}) junto con urea (100 kg ha^{-1}) tuvo un efecto significativo en el rendimiento óptimo de caupí

Palabra clave: Clorofila; Acumulación de materia seca; Rendimiento; Variedades de caupí.

† S*ubmitted May 20, 2018 – Accepted October 21, 2019.*
ISSN: 1870-0462.

INTRODUCTION

Cowpea (*Vigna unguiculata* (L) walp), as a grain legume crop, is an important source of food, income and livestock feeds and forms a major components of tropical farming systems because of its ability to improve marginal land through nitrogen (N) fixation and as cover crop, thus improving soil fertility (Danso, 2016). Cowpea has been reported to have the ability to fix 75-150 kg ha^{-1} N under good condition (Dreda, 2015). However, in other to effectively fix nitrogen, cowpea requires starter nitrogen dose necessary for initial crop establishment. This can be supplied through application of organic manure or nitrogen based fertilizer (Singh, 2018). Since it has been established that most if not all organic manure contains low level of Nitrogen, hence, there is need for complimentary use of N- fertilizer.

As earlier reported by several researchers, declined soil fertility has been identified as a major problem contributing to low cowpea yield in many part of the world where many soils lack adequate plant nutrients and organic matter (Yebu, 2015). However, the use of inorganic fertilizer has not been helpful as it is associated with increased soil acidity and nutrient imbalance (Ayoola *et al.*, 2009), cost of procurement for the low-income small scale farmers (FAO, 2017), coupled with detrimental effect of inorganic fertilizer on human and its environment are some of the reasons for advocating for the use of organic manures. Organic manures such as cow dung, poultry manure and crop residues can be used as alternative for inorganic fertilizer (Timsina, 2018). Organic manure maintain crop yield level for several years after manure or compost application ceases, since only a fraction of the nitrogen and other nutrients in the manure becomes available for plant in the first year after application thereby ensuring a long residual effect supporting better root development, leading to higher crop yield (Kasahun *et al*., 2017, Nweke, 2018). Low organic matter content in soil coupled with low and imbalanced application of macro nutrients to the crop has been reported to limits full potential of yield in crops (Sultana, 2015). Hence, integration of chemical fertilizers with organic manures has been reported to be quite promising in maintaining higher productivity in most crop production (Sohel, 2016). Combined use of organic and mineral fertilizer is a major strategy to improve soil fertility in most countries in the world. Apart from enhancing crop yield it proofs to be a promising sustainable technology having better beneficial residual effect on soil than the use of either organic or inorganic fertilizer alone. Nevertheless, few studies have evaluated the residual effects of organic amendments in combination with mineral fertilizer on crops especially on cowpea over the years. Therefore the aim of this study was to evaluate the residual effect of the initial application of poultry manure, Cow dung and Oyo organic manure with urea on photosynthetic pigment (chlorophyll), nutrient content, growth and yield performances of different cowpea varieties under field condition.

MATERIALS AND METHODS

Pre-Cropping Soil Analysis

Different fertilizer types were initially applied on maize, thereafter maize was harvested and three cowpea varieties were planted on the same plots. This was done in order to assess the residual effect of these fertilizers on cowpea performance. Before the commencement of the cowpea experiment (i.e after maize harvesting), surface Soil samples (0-15 cm depth) were taken from the experimental site. Twenty core samples collected randomly were mixed inside a plastic bucket. Also, samples were taken per plot after harvesting of cowpea. The samples were air-dried, crushed and sieved through a 2 mm sieve. Routine analyses were carried out. Samples were analyzed in the laboratory for some physical and chemical properties. Particle size analysis was done using hydrometer method (Bouyoucos, 1962) while organic matter was determined by the procedure of Walkley and Black using dichromate wet oxidation method (Nelson and Sommers, 1982). Total Nitrogen was determined by Micro-Kjeldahl digestion method (Bremmer, 1965) and available Phosphorus by BrayP-1 extraction followed by molybdenum blue colorimentry (Bray and Kurtz, 1945) and determine using spectronic 20 at 882 mm. exchangeable K, Ca and Mg were extracted by EDTA titration method (Jackson, 1962). Soil pH was determined in 1:2 soils-water ratio using digital electronic pH meter. The results of the analysis are in Table 1.

Experimental Design and Treatments

Immediately after harvesting of maize the land was left for one month thereafter, the land was manually cleared to preserve the residual nutrient of organic fertilizer used. The experiment was laid out in split-plot in randomized complete block design replicated four times. Cowpea varieties formed the main plot while residual fertilizer plots constituted the sub plots. Cowpea varieties formed the main plot while residual fertilizer plots constituted the sub plots. The initial fertilizer treatments included; T_1: Poultry manure + urea (5 t ha^{-1}+100 kg N ha^{-1}), T_2: Cow dung + urea (5 t ha^{-1}+ 100 kg N ha^{-1}), T_3: (Oyo Organic +

urea (5 t ha^{-1}+100 kg ha^{-1}) and T0: no fertilizer as the control. Three seeds/hole of cowpea varieties (Ife brown, Modupe and Ife-98-12 (improved)) were planted at 30 cm × 30 cm spacing on plot size of 5 m× 4 m (20 m^2). Established seedlings were thinned down to two plants/stand at two weeks after sowing (WAS).

Weeding

Pendilin (pendimethalin a.i) was used for weed control at the rate of 125ml/10liters of water. Being a pre-emergence herbicide it was applied on the second day of planting. Laraforce (Lambda-cyhalothrin 5% +Imidacloprid 15% a.i) an insecticide was applied at the rate of 50 ml/10 litres of water. The spraying stated after two weeks of planting and it continues for effective control of insects.

Chlorophyll Determination

Two grammes of cowpea fresh leaf samples obtained from the experimental cowpea plots were weighed and soaked in 10 mls of 80 % acetone, for chlorophyll extraction. The extract was filtered while the filtrate was made up to volume (100 mls) with 80% acetone. Five (5 mls) was then taken out of the solution and made up to volume (50 mls) with 80% acetone. Absorbance was measured at 652 nm on which spectrophotometer (name of the spec). The total amounts of chlorophyll in the leaves were calculated based on the formula of Mackinney (1941).

Total chlorophyll (c) = D652/34.5 (mg per litre) or = D652*1000/34.5 (g per litre).

Data Collection.

Five selected plants from each plot were tagged for subsequent data collection after seedling establishment. Data were collected on plant height, number of peduncle, pod length, Number of pod/plant, Number of seed/pod by visual counting, while total grains weight was obtained after harvest and drying at 12.0 % moisture level.

Data Analysis

Data collected were subjected to statistical analysis of variance (ANOVA) using SAS Institute (2004) package. The means were separated for significant differences using Duncan multiple range test (DMRT) at 5 % level of probability.

RESULTS

Soil Analysis

The results of analysis of chemical and physical properties of the soil used for the experiment showed that the soil was sandy loam in texture with pH of 6.7. Total Nitrogen was 0.15%. Exchangeable potassium, calcium; sodium and magnesium content were 0.57, 4.43, 0.37 and 0.73 $cmol_c$ kg^{-1} respectively (Table 1).

Organic Manure Analysis

The nutrient analyses for different organic manure used for the initial maize planting were shown in table 2. The nutrient analyses revealed that poultry manure was richer in all nutrients analyzed except for the sodium and calcium content. Meanwhile; cow dung had the highest mean value for Sodium content (1.98 %) while the highest calcium content was recorded for Oyo organic (2.17 %) (Table 2).

Yield Components Response of Cowpea to Initial Application of Different Organic Fertilizer sources.

Plant height

Plant heights of cowpea varieties were influenced ($p \leq 0.05$) by the effect of the residual fertilizer application in this study. Plant height of the cowpea varieties were highest in residual plots of poultry manure+ urea than those observed in residual plots of cow dung+ urea and Oyo organic +urea. Lowest plant heights were observed in cowpea plant grown in the control (no fertilizer). The cowpea varieties also varied significantly in plant heights under the different residual fertilizer plots. Cowpea variety Ife-98-12 had highest plant height and was significantly higher than Ife brown while Modupe was least.

Number of peduncle per plant.

Effect of residual fertilizer application significantly influenced number of peduncle of cowpea in this study (Table 3). A significant high number of peduncle was recorded in plots previously treated with poultry manure + urea and significantly higher than number of peduncle observed in other residual fertilizer plots. There was no significant difference in number of peduncle per plant among the three cowpea varieties.

Table 1. Pre cropping soil chemical and physical properties.

Parameters	Soil
pH (H_2o)	6.70
Total N%	0.15
Available P (mg/kg)	4.23
Org. C	0.26
Exchangeable Potassium(cmol.kg^{-1})	0.57
Exchangeable Ca (cmol.kgv)	2.01
Exchangeable Na(cmol.kg^{-1})	0.17
Exchangeable Mg(cmol.kg^{-1})	0.73
Sand (%)	775
Silt (%)	147
Clay (%)	107

Table 2. Chemical composition of the animal wastes and organic fertilizer used for the studies.

Parameters	Poultry manure	Cow dung	Oyo organic
pH (H_2O)	5.10	7.50	6.90
N (%)	4.10	2.30	0.61
Total P (%)	2.40	1.80	0.62
Org. C (%)	13.76	10.78	6.08
K (%)	2.67	2.13	1.98
Ca (%)	3.17	1.89	2.05
Na (%)	1.67	1.98	0.78
Mg (%)	3.23	2.12	0.54
Fe (%)	1.97	1.56	0.47

Pod length

Fertilizers residual effect and variety on pod length of the three cowpea varieties differed significantly in this study. Cowpea pod lengths were longest in poultry manure+ urea residual plots. This was followed by pod length observed in cow dung + urea residual plots which were not significantly different from cowpea pod length observed in Oyo organic + urea plots. The control however had the least pod length. Cowpea variety Ife-98-12 had the longest pod length, followed by cowpea variety Ife brown while cowpea pod length were least in cowpea variety Modupe.

Number of pod per plant.

The number of pod formed per plant was influenced by fertilizer residual effect and variety ($p<0.05$). Highest number of pod per plant was observed in poultry manure + urea residual plots; this was followed by cow dung + residual plot while least number of pods per plant was observed in the control. Cowpea variety Ife-98-12 with longest pod length also had the highest number of pod per plant while Modupe which had the least pod length also had least number of pods per plant.

Number of seed per pod and grain yield.

Residual fertilizer effect and variety on the number of seed per plant and total grain yield were significant ($p<0.05$). Highest number of seeds per pod and grain yield were observed in poultry manure + urea residual plots and these were significantly higher than number of seed per plant and grain yield of other residual plots and the control. There were no significant difference between the number of seed per pod and grain yield between Cowpea varieties Ife-98-12 and Ife brown respectively but significantly higher

than Modupe. Generally, the application of poultry manure augmented with urea (5 t ha^{-1} 100 kg ha^{-1}) performed better than all the treatments applied on all the growth and yield parameters (Table 3).

Effect of Initial Application of Different Organic Manure Sources on three Cowpea Varieties in Ibadan.

Among all the varieties, Ife 98-12 significantly produced the highest mean values for all the parameters considered with the exception of number of peduncles where no significant difference was recorded among all the varieties.

Interaction Effect of treatments and variety on growth, Yield, chlorphyll concentration and Dry matter accumulation.

All parameters were significantly influenced by interaction effect of treatments and varieties as Ife 98-12 with poultry manure +urea significantly produced the highest mean value for all the treatments.

Effect of Initial Application of Different Organic Manure Sources on Post cropping Soil Nutrient Analysis.

Soil analysis after harvesting showed a significant increase ($p<0.05$) in nutrient content of the soil treated with soil amendments. After the first trial, application of poultry manure augmented with urea had the highest Nitrogen content in the soil. Whereas, no significant difference was observed in soil amended with cow dung+ urea and Oyo organic + urea with the mean value of 2.16 and 1.57 % respectively. The trend was the same at the second trials with Poultry manure+ urea being significantly different from all treatments and all fertilizer treatments were significantly higher than control (Table 6).

At both trials, highest phosphorus content was observed in soil previously amended with poultry manure + urea and it has higher significant effect compared to other treatments applied while the least phosphorus content was observed in control soil. Application of poultry manure significantly ($P<0.05$) increased the soil potassium, magnesium and sodium concentration more than all fertilizer source and control at both trial. Similarly, soil organic carbon and iron were much higher in soil treated with poultry manure+ urea compared to other fertilizer source. Whereas the opposite was true for the soil calcium content where soil amended with cow dung +urea had the highest calcium compared to other treatments (Table 6).

Residual Effect of Initial Application of Different Organic Manure Sources on Dry Matter Accumulation of Cowpea Varieties

Total Fresh weight: The total fresh weight of cowpea plants treated with Poultry manure + urea was significantly higher than those treated with cow dung + urea and Oyo organic + urea (5 t ha^{-1} + 100 kg ha^{-1}). Initial application of poultry manure +urea increased the total dry weight by 148 %, followed by cow dung+ urea and Oyo organic + urea which their applications increased total fresh weight of cowpea by 130 and 125 % respectively compared to the control treatment (Fig 2).

Total Dry weight: Similar trend observed with total fresh weight was also recorded for total dry weight. Total dry weight was significantly higher in all cowpea plants treated with poultry manure + urea compared to cow dung+ urea, Oyo organic + urea and control (Fig 2).

Residual effect of Different fertilizers on the Chlorophyll contents of Three Cowpea Varieties.

Residual effect of poultry manure augmented with urea (5 t ha^{-1} + 100 kg ha^{-1}) significantly favored chlorophyll formation in cowpea leaves more than cow dung + urea, Oyo organic + urea and the control. Similarly, chlorophyll content were significantly higher in leaves of cowpea plants grown in residual plots of Cow dung with urea than those grown under residual plots of Oyo organic + urea (Fig 1).

DISCUSSION

Different ions in the soil actually contribute to the evident results observed in the soil, plant and subsequently in the yield of the crop (Singh, 2018). Nitrogen (N), phosphorus (P) and potassium (K) among other nutrients are present in the soil in ionic form and essential for the growth and yield of crops (White and Brown, 2010). Phosphorus deficiency has been identified as the most limiting nutrient in cowpea production (Karikari *et al*., 2015). This is majorly attributed to the inherent low P in soils of the tropics, which could also be due to the immobility of P in soils. Cowpea has the ability to fix nitrogen and will need little or no N but most soils in the tropics are low in N (Haruna and Aliyu, 2011). However, fertilization of a soil with N and K among other nutrients will have a residual effect on the successive crops grown on such soils (Bitew and Alemayehu,

2017). This was evident in the results observed when cowpea was planted on a soil previously fertilized with organic and mineral fertilizer. The combination of poultry manure and urea however had the most significant residual effect on the cowpea grown and this was evident in the soil, plant and the yield of cowpea. In the soil, N, P and K concentration was higher in the soil cropped with poultry manure and similar results have been observed by other authors. This translated to what was observed in the results of the plant tissue concentrations, with observation of the uptake of N, P, K, Mg, Zn and Fe. A similar result was observed by Solomon *et al.,* 2014.

Nitrogen has been identified as a key factor of yield increase (Masclaux-Daubresse *et al*., 2010). The high yield component obtained for cowpea could be attributed to an adequate supply of N from the previous application of organic and mineral fertilizer as well as the ability of cowpea to fix nitrogen. Nitrogen is a major component of chlorophyll. In this study, cowpea plants responded better with respect to chlorophyll content with the application of poultry manure and urea. High yield obtained as a result of the application of poultry manure in combination with urea might probably be as a result of high chlorophyll content since chlorophyll is fundamental to photosynthetic activity which allows plants to absorb enough energy which is later converted to food thereby resulting to high plant growth and development.

CONCLUSION

The study concludes that poultry manure in combination with urea enhances soil nutrient status such that its residual effect in the soil resulted in higher growth and grain yield of three cowpea varieties than other organic manure- urea combinations. Considering the beneficial role of poultry manure with urea in improving soil fertility and potential to sustain high crop production, it is therefore recommended that the use of poultry manure in combination with urea in crop production should be encouraged because of its long-term residual effect for subsequent crop production.

Acknowledgement
The authors would like to acknowledge all field staff of the Institute of Agricultural Research and Training for their assistance during the field trial.

Conflict of interest. The authors confirm that there are no known conflicts of interest associated with this publication.

Data availability. Data are available with the corresponding author (kennysaint87@yahoo.com) upon reasonable request.

Table 3. Effect of Varieties and residual fertilizers on the Growth and yield Components of three Cowpea varieties in Ibadan.

Treatments	Plant height(cm)	No of peduncle	Pod length(cm)	No of pod/plant	No seed/pod	Yield t ha^{-1}
Varieties						
Ife brown	26.95^{b}	8.29^{a}	13.41^{b}	16.08^{b}	14.86^{a}	2.52^{a}
Modupe	23.58^{c}	8.34^{a}	10.92^{c}	13.78^{c}	11.75^{b}	2.04^{b}
Ife-98-12	29.88^{a}	8.57^{a}	16.52^{a}	18.67^{a}	16.13^{a}	2.76^{a}
Residual Organic fertilizer						
No fertilizer	12.77^{d}	4.93^{d}	7.32^{c}	7.38^{d}	7.40^{c}	0.90^{d}
PM+ urea	39.30^{a}	13.57^{a}	19.57^{a}	23.14^{a}	19.07^{a}	4.45^{a}
CD+ urea	23.55b	11.35^{b}	15.11^{b}	16.95^{b}	14.38^{b}	2.83^{b}
Oyo organic +urea	21.01^{c}	9.09^{c}	13.75^{b}	14.09^{c}	13.41^{b}	1.90^{c}

Means followed by the same letter within a column are not significantly different according to DMRT at P≤0.05
CD: Cow dung, PM : Poultrymanure

Table 4. Interaction Effect of Varieties and residual fertilizer on Growth and yield Components of three maize varieties in Ibadan.

Treatments x varieties	PH (cm)	No of peduncle	Pod length (cm)	No of Pod/plant	No seed/pod
Control x Ife brown	13.83	4.33	7.76	8.41	8.00
Control x Modupe	11.66	4.00	5.85	7.08	7.50
Control x Ife 98-12	15.20	5.66	8.60	9.98	9.56
Poultry manure x Ife brown	42.00	12.06	19.03	28.58	23.00
Poultry manure x Modupe	37.66	10.73	15.78	20.65	16.50
Poultry manure x Ife 98-12	45.53	12.83	25.10	31.33	24.00
Cow dung x Ife brown	31.23	11.06	15.23	19.50	16.16
Cow dung x Modupe	27.46	10.23	12.63	16.58	13.91
Cow dung x Ife 98-12	36.03	9.46	19.18	20.71	18.22
Oyo organic x Ife brown	26.76	6.66	13.90	13.50	15.66
Oyo organic x Modupe	21.53	9.66	11.53	14.85	12.93
Oyo organic x Ife 98-12	27.16	8.38	16.81	18.68	16.46
S.E±	1.3	0.51	0.64	0.95	0.76

PH: Plant height, S.E:Standard Error

Table 5. Interaction Effect of Varieties and residual fertilizer on Physiological Components of three Cowpea varieties in Ibadan.

Treatment x variety	Chlorophyll	TFW	TDW	Yield t ha^{-1}
Control x Ife brown	0.93	83.80	23.70	1.13
Control x Modupe	0.87	88.35	26.10	0.79
Control x Ife 98-12	1.23	95.47	30.17	1.01
Poultry manure x Ife brown	3.12	291.22	104.67	5.06
Poultry manure x Modupe	3.88	294.22	110.40	3.95
Poultry manure x Ife 98-12	4.61	304.75	118.37	5.31
Cow dung x Ife brown	2.83	263.95	75.85	2.75
Cow dung x Modupe	2.95	238.32	87.02	2.65
Cow dung x Ife 98-12	3.29	231.62	87.72	3.35
Oyo organic x Ife brown	2.61	197.20	61.45	2.25
Oyo organic x Modupe	2.74	200.72	66.30	1.56
Oyo organic x Ife 98-12	2.91	233.05	66.10	2.47
S.E±	0.16	11.74	4.62	0.17

S.E: Standard Error, TFW: Total Fresh Weight, TDW: Total Dry Weight

Table 6. Residual Effect of Fertilizer Application on the Post-cropping Soil Nutrient Compositions.

	1st T	2nd T	1st T	2nd T	1st T	2nd T	1st T	2nd T	1st T	2nd T	1st T	2nd T	1st T	2nd T	1st T	2nd T
Trt	**N (%)**		**P (%)**		**K (%)**		**Mg(%)**		**Na (%)**		**Fe (%)**		**Org. C(%)**		**Ca (%)**	
FO	1.20^{c}	1.37^{c}	0.49^{b}	0.52^{b}	0.85^{b}	0.38^{d}	0.62^{c}	0.41^{d}	0.72^{b}	0.44^{d}	0.28b	0.29d	5.46b	4.55b	1.22c	0.84b
F1	3.02^{a}	3.90^{a}	1.49^{a}	2.04^{a}	1.85^{a}	2.47^{a}	2.67^{a}	3.04^{a}	1.59^{a}	1.95^{a}	1.41a	1.54a	10.30a	11.16a	3.01ab	3.17ab
F2	2.16^{b}	2.51^{b}	1.26a^{b}	1.69^{ab}	1.43^{ab}	1.96^{b}	1.79^{b}	2.20^{b}	1.17^{ab}	1.68^{b}	0.94ab	1.16b	8.60ab	10.10ab	3.26a	3.70a
F3	1.57^{b}	1.85^{b}	1.14^{ab}	1.44^{ab}	1.06^{b}	1.14^{c}	1.37^{b}	1.42^{c}	1.12^{ab}	1.47^{c}	1.02ab	0.93c	7.50ab	9.71ab	2.94ab	2.15ab

Means followed by the same letter in a column are not significantly different from each other at P≤0.05 by DMRT

TRT: Treatments, 1st T: first trial, 2nd T: second trial, F0: No fertilizer, F1: poultry manure (5 t ha^{-1}) + urea (100 kg ha^{-1}), F2: Cow dung (5 t ha^{-1}) + urea (100 kg ha^{-1}), F3:Oyoorganic(5tha^{-1})+urea(100kgha^{-1})

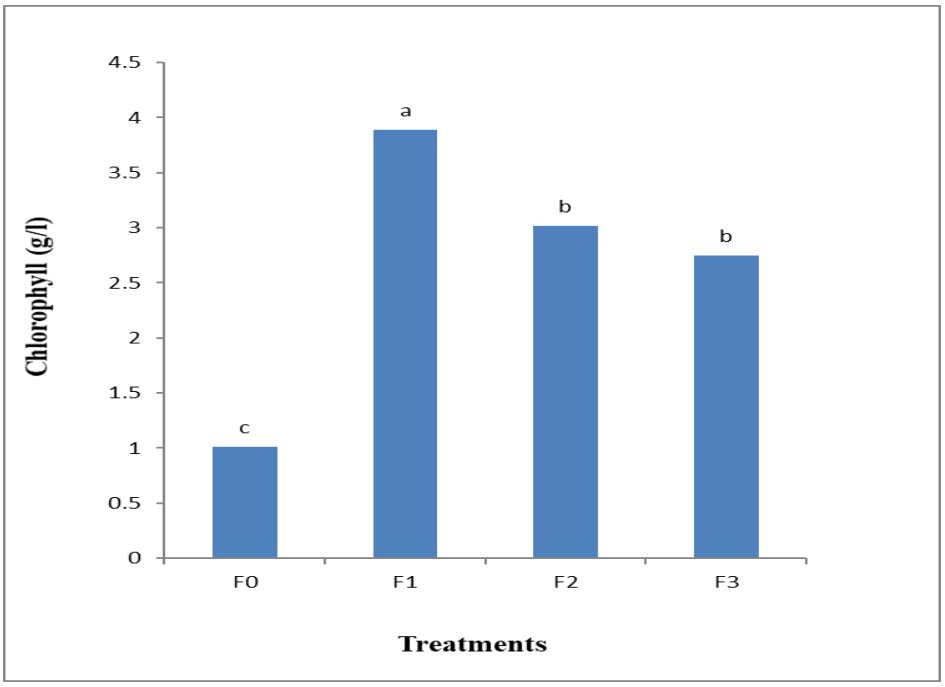

Figure 1. Residual effect of Poultry manure, Cow dung and Oyo organic manure integrated with Mineral fertilizer on the chlorophyll content of cowpea (F0: Control, F1: Poultry manure + urea, F2: Cow dung+ urea, F3: Oyo organic+ urea).

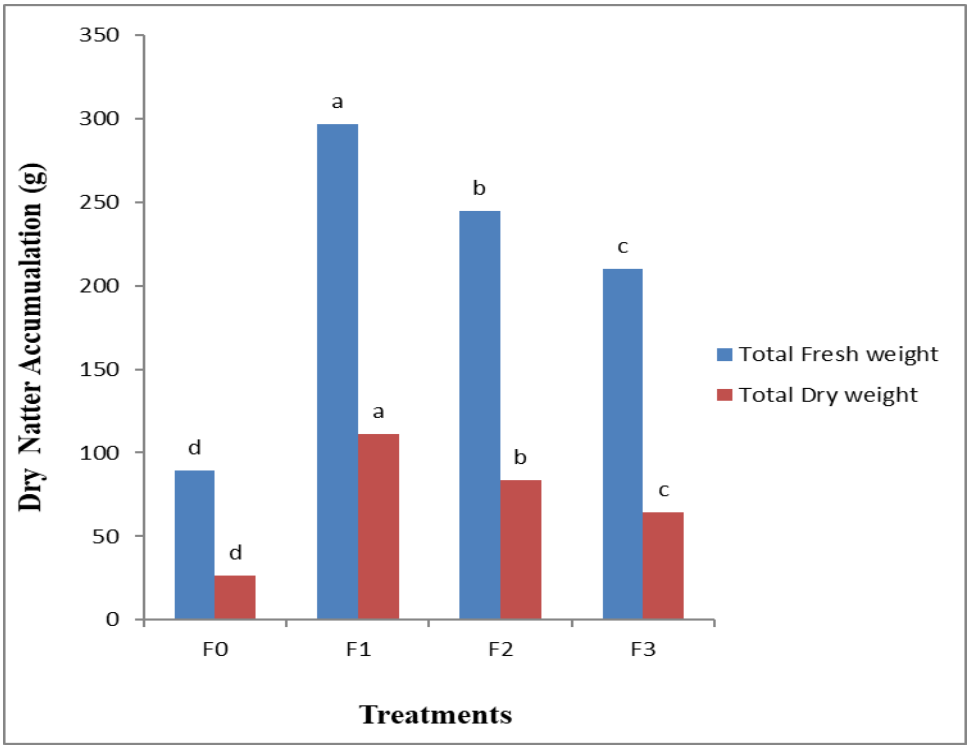

Figure 2. Residual Effects of Poultry, Cow dung and Oyo organic manure integrated with Mineral fertilizer on Dry matter Accumulation of three Cowpea varieties in Ibadan (F0: Control, F1: Poultry manure+ urea, F2: Cow dung + urea, F3: Oyo organic+ urea).

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