Journal of Agriculture and Food Sciences
Volume 21, Number 2, October 2023, pp 177 - 190

RESPONSE OF ROOT GROWTH PARAMETERS AND NUTRIENT UPTAKE OF COWPEA (*Vigna unguculata L.)*TO RATES OF ORGANIC MANURE

Ogbuehi H.C and Emeribe E.O
Department of Cropscience and Biotechnology,Faculty of Agriculture, Imo State University,P.M.B 2000,Owerri, Nigeria
Corresponding author's email:hyginusogbuehi@gmail.com

ABSTRACT

This study was carried out to investigate the effect of different organic manure sources on Root growth parameters and nutrient uptake of cowpeas (Vigna unguiculata L.). The experiment was conducted at the Teaching and Research Farm of the Faculty of Agriculture, Imo State University, Owerri. The experiment was laid out in a Randomized Complete Block Design (RCBD), with five treatments replicated four times. The treatments are 0 ton T_1 *(Control),* T_2 *(10tons and pig manure),* T_3 *(15tons of pig manure),* T_4 *(10tons of poultry manure), and* T_5 *(15 tons of pig manure). From the result of the experiment, the application of poultry manure significantly improved, the number of roots, root length, root dry matter, phosphorus, and potassium uptake at various growth stages of data collection. The result also showed that pig manure significantly improved the percentage of emergence, plant height, number of leaves, Nitrogen uptake, and high number of pods (9.75), seed weight (101.47g), and yield 924.16kg/ha). The cowpea responded significantly in both root growth parameters and nutrient uptake to pig manure and poultry manure at the rates used.*

Keywords: Cowpea, Growth, Yield, Nutrient uptake and Organic manure.

https://dx.doi.org/10.4314/jafs.v21i2.13

INTRODUCTION

Cowpea (vigna unguiculata) is a legume crop that has been widely cultivated in tropical and subtropical regions of the world due to its high protein content and adaptability to poor soil conditions.However, the productivity of cowpea can be limited by factors such as low soil , fertlity,drought and poor management practices.one way to improve the productivity of cowpea is using organic amendments such pig maunre and poultry manure , can provide essential nutrients and improve soil healthOver the years traditional farmers have perfected the act of using manure soorces from animals especially, poultry,pigs,gaots and crop residues as source of enriching the soil thereby making food available for optimum plant growth.The use of organic inputs such as crop residues and manures has great potential for improving soil productivity and crop yield through improvement of the soil physical, chemical, microbiological properties and nutrient supply (Abbasi *et al.,* 2009). Inputs from organic sources (e.g.animal dropings, compost and sewage sludge) play a central role in the productivity of many tropical farming systems by providing nutrients through decomposition and substrate for the synthesis of soil organic matter.Imbalanced use of chemical fertilizers

Journal of Agriculture and Food Sciences
Volume 21, Number 2, October 2023, pp 177 - 190

by farmers has deteriorated soil health and declined soil organic carbon content. It is essential to adopt a strategy of using organic manures. Organic manures enhances the soil fertility and yield of crops by rendering unviable sources of elemental nitrogen bound, phosphate and decomposed plant residues into available form in order to facilitate the plant to absorb the nutrients (Timsina Jagadi,2018).Moreover, Cowpea is a valuable component of farming systems in many areas because of its ability to restore soil fertility for succeeding cereal crops grown in rotation with it (Carsky *et al.,* 2002; Tarawali *et al.,* 2002; Sanginga *et al.,* 2003). Atmospheric nitrogen fixing ability is extremely valuable when it is cultivated with cereal crops in crop rotation system (Timko *et al.,* 2007). Cowpea crop increases soil nitrogen up to 40–80 kg per hectare (Quin, 1997 and Anil *et al*., 2019).

In Nigeria, loss of soil fertility and rainfall variability are among the factors that contributed to low yields. Studies on the predominantly sandy soils have shown the complexity of soil fertility problems (Giller, 2001).There are slim chances of building soil organic matter in the dry tropics and, hence, nutrient stocks (Giller *et al*., 1997), rendering farmers to rely heavily on external nutrient inputs on a seasonal basis. However, most of the smallholder farmers use sub-optimal amounts of fertilizers due to cash limitations and poor access to fertilizer markets. Therefore, it is important to recycle both endogenous and exogenous nutrient pools. Moreover, continuous use of fertilizer alone cannot sustain crop yield and maintain soil fertility in the long term (Shoko *et al*., 2007; Tisdale *et al*., 1999).

Gupta and Sharma (2006).have reported that organic sources of nutrients improved soil aeration, root development and increase microbial and biological activities in the rhizosphere. Mahatele and Kushwaha (2011), reported that addition of FYM at 10tha^{-1} to soil improved the supply of available nutrient to the plant and brought about favorable soil environment which ultimately increased nutrient and water holding capacity of soil for longer period and that resulted in better growth, yield attributes and yield of Pigeon pea. The application of organic amendments can potentially stimulate crop growth and development through the actions of plant growth-promoting hormones, including cytokinins, auxins, and gibberellins (Quilty and Cattle, 2011). Pradeep *et al*. (2012), stated that different bio-composts could enhance seed germination and seedling vigour in four different crops such as maize, green gram, soybean and okra

Organic fertilizer play vital role as a major contributor of plant nutrients. Many workers have tried to assess the importance of organic manures in crop production. Senjobi *et al.* (2010), reported that the use of poultry, sheep/goat manures improved all the growth parameters of the leaf vegetable they worked with.

The addition of organic fertilizers efficiently ensures high production and continuous crops by improving soil properties and increase roots development and soil micro organisms activity (Abou EL-Magd *et al*., 2006; Ayoola and Maknide, 2009).John *et al*. (2004) who reported that poultry manure contains essential nutrients which are associated with high photosynthetic activities that promote root and vegetative growth. The addition of organic fertilizers efficiently ensures high production and continuous crops by improving soil properties and increase roots development and soil micro organisms activity (Abou EL-Magd *et al*., 2006; Ayoola and Maknide, 2009), Dademel *et al*. (2004) reported that the nitrogen content in both organic fertilizers has been known to enhance leaf production, flowering, seed formation and root formation, this will lead to higher metabolic activities and consequently higher fresh fruit yield in okra.The response of root growth parameters to organic manure is also important, as it can affect the uptake of nutrients by the plant. Studies have shown that organic manure can increase the length and diameter of cowpea roots, which can improve the uptake of nutrients from the soil (Oke et al., 2017). Additionally, organic manure can increase the number of lateral roots and root hairs, which can also improve nutrient uptake (Akpa et al.,2017).The nutrient uptake of cowpea in response to organic manure is also an important area of research. Studies have shown that organic manure can increase the uptake of nutrients such as nitrogen, phosphorus, and potassium by cowpea (Kumar *et al*., 2018).

Most of research work on cowpea has always centred on above ground parameters without much work on root growth indices,this could be attributed to a labourios nature on the study of root architecture and structure of legumes by Researchers. pig manure and poultry manure have bean shown to increase rootlegnth and diameters in other crops, but effects on cowpea root growth parameters are not well understoodHence this study is done to add to knowledge on information on root growth paramters and its importants in the growth of crops .

MATERIALS AND METHODS

Location

This study was carried out in the Teaching and Research Farm of the Faculty of Agriculture and Veterinary Medicine, Imo State University,Owerri, during late planting season of 2021. Owerri lies between the latitudes 5^{o}10'N and 6^{o}0'N and longitudes 6^{o}35'E and 7^{o}0'E with an altitude of 91.0m within the Southeast rain forest agricultural zone of Nigeria. The area maintains an average annual rainfall of 2,500 mm, mean minimum and maximum temperature of 23.5^{o}C and 32.1^{o}C respectively, with relative humidity ranging from 70-85% and the annual evapotranspiration is 1450 mm (NIMET, 2010).

Source of Materials

Plant materials that were used in this study were collected from Imo State University Teaching and Research Farm. Cowpea beans seeds were source from Imo ADP.

Experimental Design

The experimental design was a randomized complete block design with 5 treatments replicated four times. Treatments used consist of 0 ton T_1 (Control), T_2 (10tons of pig manure), T_3 (15tons of pig manure), T_4 (10tons of poultry manure), and T_5 (15 tons of pig manure)

Planting and Agronomic operations

cowpea seeds were planted at a depth of 2-3cm, spacing of 50cm × 50cm and four seeds were sown per hole on each 1m × 1m bed. After germination, the seeds were thinned to one seedling per stand. Weeding was done regularly by handpicking throughout the period of research, to keep the beds weed free.

Journal of Agriculture and Food Sciences **Ogbuehi H.C and Emeribe E.O**
Volume 21, Number 2, October 2023, pp 177 - 190

Data Collection

The following parameters were collected:

Root length: Five plants were randomly selected for measurement of root length and this was done using centimetre ruler.

Number of Roots: The numbers of roots were counted visually by carefully separating them from the soil by gently pinching and washing the soil particles

Root Dry Weight: To measure root dry matter, in every step, roots were put in an oven at 57 C for 48 hrs; then they were weighed with a scale with measurement

Root Nodules: The number of root nodules was counted by carefully separating them from the soil by gently pinching and washing the soil particles

Total uptake of N/P/K will be calculated separately by the following formula:

$$\text{Uptake of N/P/K (kg ha}^{-1}) = \frac{\text{N\% P\% K\%} \times \text{dry matter kgha}^{-1}}{100}$$

Statistical Analysis

Data obtained was subjected to statistical analysis using Analysis of Variance (ANOVA) to determine if the treatments have any significant effect on parameters measured. All data were analyzed according to One-Way ANOVA using SPSS software version 20.0.

RESULTS

Effect of Treatments on Number of Roots

The response of number of roots to application of organic manure is presented in Table 1. The result reveals that source of manure and rate significantly ($P<0.05$) influenced number of roots. The results showed that At 2 and 4WAP, T_2 recorded significantly highest number of roots (8.500 and 15.500 respectively) compare to the lowest (5 and 11.5 respectively) number of roots obtained from T_1. At 6 WAP, showed that T_3 recorded the highest number of roots (18.75) which was significantly different ($P<0.05$) from the lowest number of roots (13.250) observed from T_5. This was followed by control with 18.50 T_2 with mean number of roots (17.50), while at 8 WAP T_3 recorded significantly highest (27.500) number of roots compare to the lowest (19) observed in T_2. Control was able to give better result than T_2 and T_5 as shown in Table 6. Whereas at 10WAP, T_4 recorded highest number of roots (38.750) which was significantly different ($P<0.05$) compare to the control with 24.25 number of roots. This was followed with T_3 with number of roots as 30.250, T_2 with number of root as 27.250 while T_5 recorded 24.500 of number of roots. They results are statistically different. It was observed at the end of experiment that 10tons of poultry manure performed better than chicken manure.

Journal of Agriculture and Food Sciences
Volume 21, Number 2, October 2023, pp 177 - 190

Effect of Treatment on Root Length of Cowpea

The influence of organic manure source and rate of application on root length at different growth stage of cowpea is presented in Table 2. There was no significant different ($P<0.05$) on the result shown except at 10WAP. It was evident from Table 2, that T_3 at 2WAP recorded the longest root length (4cm) which was not significantly different ($P<0.05$) from the shortest root length (3.125cm) observed from T_2. At 4WAP, T_4 had the highest root length (7.475cm) compare to the lowest root length (6.150cm) obtained in T_1. This was followed by T_3 with root length of 7.425cm and T_4 with root length of 7.0750cm while T_2 gave 6.475cm of root length. At 6WAP there was no significant different among treatments as T_4 recorded root length of 11.725cm, followed by T_3 with 11.425cm, T_2 gave 11.1750cm of root length, among the treated plots T_5 gave the lowest root length (10.825cm) compare to control with 10.975cm of root length. Also at 8WAP, T_3 gave the highest root length (15.700cm) which was statistically similar to other root lengths 14.400cm, 14.650cm, 14.700cm and 14.800cm respectively from T_1, T_5, T_4 and T_2 in that order whereas at 10WAP T_5 produced significantly maximum root length (21.950cm) compare to the minimum (18.500cm) recorded from control. This was closely followed by T_3 with root length of 21.925cm which was statistically similar to those of T_4 (20.850cm) and T_2 (20.375cm) as shown in Table 2.

Effect of Treatment on Number of Root Nodules

Table 3, showed that effect of manure source and rate of application did not have significant different ($P<0.05$) on number of root nodules. It was observed that nodules did not form at 2 and 4WAP as shown in Table 3. However, at 6WAP,8WAP and 10WAP there was no statistical diffference observeed in the number of root nodules for all observed treatment.It was observed that type of manure and rate applied different on number of root nodules recorded.

Effect of Treatment on Root Dry Matter

The effect of sources of organic manure and rates of application on root dry matter is presented in Table 4. There was significant different ($P<0.05$) among the treatment levels and manure source on root dry matter. At 2WAP T_4, significantly recorded maximum root dry weight (2.0568g) compare to the minimum root dry weight (0.9303g) observed from T_2. At 4, 6, 8 and 10WAP T_5 produced maximum root dry matters (4.082g, 6.4988g, 8.8375g and 9.105g respectively) which were significantly different ($P<0.05$) from the minimum root dry matters (1.3665g, 2.5623g, 3.6765g and 4.3215g). This was followed by T_4 with second highest maximum root dry matter compare to T_2 and T_3 as shown in Table4. Poultry manure at 15 tons and 10tons significantly improved root dry matter when compare with pig manure.

Effect of Treatments on Nitrogen Uptake

The response of Nitrogen uptake by the root of cowpea influence by manure source and rate of application is presented in Table 5. There was significant different ($P<0.05$) among the source and treatment level on nitrogen uptake as weeks increases. At 2WAP T_4 recorded significantly maximum Nitrogen uptake (0.059%) which was significantly different ($P<0.05$) from minimum (0.0875%) Nitrogen uptake observed in T_1. This was followed by T_5 with

Journal of Agriculture and Food Sciences
Volume 21, Number 2, October 2023, pp 177 - 190

Nitrogen uptake of 0.05675g while T_3 had 0.0405% and 0.02475% of Nitrogen uptake. At 4, 6, and 8WAP, T_5 (15 tons of poultry manure) significantly recorded the maximum Root Nitrogen uptakes (0.12325%, 0.3135% and 0.4105% respectively). Compare to the minimum Nitrogen uptakes (0.02425%, 0.049% and 0.11875%) observed in T_1. This was followed by T_4 with Nitrogen uptake 0.085%, 0.1915% and 0.30375% respectively, which was significantly different (P<0.05) from other intermediate levels. At 10 WAP, T_2, recorded the maximum Nitrogen uptake (0.5850%) which was significantly different (P<0.05) from the lowest (0.21675%) obtained in T_1. It is observed that among treatment level, T_3 at 10WAP recorded significantly lowest Nitrogen uptake (0.37025%) compared to other treated plots.

Effect of Treatment on Phosphorus Uptake

The results of the influence of manure type and rates on phosphorus uptake of cowpea is presented in Table 6. Organic manure treatments significantly (P<0.05) influenced phosphorus uptake as weeks increases. The values of phosphorus uptake was maximum (11.3675ppm) from T_5 at 2WAP compare to the minimum observed in control. Also at 4WAP, 15ton/ha rate of poultry manure (T_5) recorded the highest Phosphorous uptake (29.2785ppm) which was significantly different (P<0.05) from the lowest (6.2823ppm) Phosphorous uptake from control. 10tons/ha rate (T_4) gave higher Phosphorous uptake (22.763ppm) than 15tons/ha rate of pig manure with Phosphorous uptake of 13.695ppm and T_2 (10ton/ha rate of pig manure) with Phosphorous uptake of 10.8778ppm.

Also values of Phosphorous uptake at 10ton/ha rate (T_4) and 6WAP growth stage shows that poultry manure (T_4) treatment recorded the highest (51.067ppm) P uptake while the least (13.6835ppm) was observed in control. Among the treated plots, 10ton/ha rate (T_2) of pig manure recorded significantly least (27.6693ppm) P uptake compared to T_3, and T_5. Similarly, at 8 and 10WAP T_5 (15ton/ha of poultry manure) significantly recorded the maximum phosphorous uptake (77.308ppm and 88.8075ppm respectively) compare to the least P uptake (21.4658ppm and 31.156ppm) obtained in control. However, it was observed that poultry manure both 15ton/ha and 10ton/ha rates significantly stimulated the uptake of Phosphorous more than pig manure as shown in Table 7.

Effect of Treatments on Potassium Uptake

The response of potassium (K) uptake to source and rates of organic manure application is shown in Table 7. There were significant differences (P<0.05) in potassium (K) uptake as affected by source and rates applied organic manure. At 2WAP and 4WAP growth stages, plants that received 15t/ha^{-1} of poultry manure (T_3) recorded the highest K uptake (0.621% and 1.5103% respectively) which were significantly different (P<0.05) from the least K uptake (0.0823% and 0.160% respectively) observed in T_1. Among the treated plots 10t/ha^{-1} rate (T_2) of pig manure recorded the least followed by 15t/ha^{-1} of pig manure (T_3) as shown in table 7.Similar trend was observed at 6, 8 and 10WAP were 15t/ha^{-1} of poultry manure (T_5) recorded the highest K uptake (2.6923%, 5.4563% and 7.3908% respectively) compare to the K uptake (0.3587%, 1.659% and 2.696%) observed T_2 (10t/ha of pig manure) recorded higher K uptake (2.854% and 5.444%) than K uptake (1.8915% and 4.3183% respectively) by 10tha^{-1} + poultry manure. In all, T_5 influenced K uptake than any other treatment level.

Journal of Agriculture and Food Sciences
Volume 21, Number 2, October 2023, pp 177 - 190

DISCUSSION

The result showed that the application of Pig manure and Poultry manure could improve root length, number root, number of nodules and root dry matter compare to control, although, the response is dependent on manure type, rate and environmental factors. This improvement could be due to fact that application of pig manure and poultry manure to soils provide more nutrients to maintain root growth parameters thereby maintained the supporting function of the cowpea plant. This is in conformity with Udom *et al.* (2007), and Waniyo *et al.* (2013), who reported that, organic manures supply nutrients to plants, improves soil structure, aeration and encourages good root growth which may invariably had resulted in increased growth and yield of the maize plant.

Similarly, Abou El-Magd *et al.* (2006), and Ayoola and Makinde, (2009), have reported that addition of organic fertilizers efficiently increase roots development, high production and continuous crops by improving soil properties and soil microorganisms. Also Gupta and Sharma(2006) have reported that organic sources of nutrient improved soil aeration root development and increase microbial and biological activities the rhizosphere.

It was observed that application of organic manure (pig manure and poultry manure) could enhanced the soil organic matters which improve soil structure and availability of essential nutrient that could contribute to cowpea growth and yield by directly supplying essential nutrients and indirectly modifying soil physical structures that can improve the root growth, rhizosphere and enhanced plant growth. Our observation is in agreement with work of Akinrinde et al. (2017) who investigated the effect of pig and poultry manure on the growth of cowpea. Their results showed that cowpea plants treated with pig and poultry manure exhibited significantly higher shoot length, root length, leaf area, and biomass compared to control plants without any fertilizer application. This indicates that both pig and poultry manure can promote the growth of cowpea roots.

In addition, organic manure application also affects the accumulation of macro and micro elements in the soil. It was observed that plant growth rates are influenced by elements of Nitrogen (N), Phosphorous (P) and Potassium (K). N element as a constituent of chlorophyll, division and cell enlargement in the apical meristem, activity of the apical meristem generated the shoot growth thereby enhancing overall plant height (Purberjanti *et al.,* 2019).

Superiority of poultry manure on root parameters (length of root, number of roots, root nodules and root dry matter) over pig manure could be because it increases macroelement content in the cells and enhanced their division due to high organic matter and micronutrients present in it.

In this study, it was observed that organic manure types and rate significantly enhanced nutrient uptake by the root of cowpea. This could be due to fact that organic manure increases organic matter content, nutrients bioavaiability and increased microorganisms activities that improved solubility, mineralization and absorption of these essential nutrient thereby improves root growth parameters and above ground parameter.Adewole and Ilesam, (2011), concluded that organic-based fertilizer enhanced the bioavailability of plant nutrients, and thus, improved the uptake nutrients by the okra plant roots. Uptake of N, P, K and Ca, were

Journal of Agriculture and Food Sciences
Volume 21, Number 2, October 2023, pp 177 - 190

enhanced significantly by the rate and types of manure applied, Adewole and Ilesam, (2011), reported that organic fertilizer enhanced the uptake of nutrients (N, K, Na and Cu, Ca) more than any other soil amendments. The study by Kumar etal.(2018) provides valuable insights into the effects of organic manure on nutrient uptake in cowpea.Pig and Poultry manure when applied to cowpea cultivation can enhance the availability of N,P and K which are crucial elements for plant growth and development.

Pig and poultry manure not only provide essential nutrients but also enhance nutrient availability in the soil. The organic matter in the manure improves soil structure, water-holding capacity, and nutrient retention, facilitating better nutrient uptake by plant roots. A study by Ojeniyi *et al*. (2018) evaluated the effect of pig and poultry manure on nutrient uptake in cowpea. The results revealed that plants treated with pig and poultry manure had significantly higher concentrations of nitrogen, phosphorus, potassium, calcium, magnesium, iron, zinc, copper, and manganese in their roots compared to control plants. This indicates that the application of pig and poultry manure enhances the nutrient uptake capacity of cowpea roots.

The maximum production of root growth parameters as determined by root length, number of root and root dry matter when poultry manure and pig manure were applied could be attributed to the steady release of nutrients (N, P, K and Ca) upon decomposition of organic manure that enhanced growth and yield of cowpea. This is consistent with work of Waniyo *et al.* (2013), who reported the same findings in maize.

In this study, it was observed that N, P and K uptake at later growth stage (10WAP) of cowpea plant were higher in the root evaluated, this could be attributed to steady availability of macro element and micro nutrients in the soil which were slowly release due to microbial action on decomposition of organic manure. This is consistent with findings of Akintonye and Olaniya, (2012) and Waniyo *et al.* (2013), that organic fertilizers release nutrients slowly.

In this study poultry manure significantly improved more root dry matter, phosphorus and potassium uptake, number of roots, root length and number of nodules compare to the pig manure.

CONCLUSION

In conclusion, the application of pig and poultry manure can have a significant impact on the growth and nutrient uptake of cowpea roots. Poultry manure application rate of 10tons and 15tonha^{-1} exerted significant influence on number of roots, root length, root dry matter number of nodules, uptake of phosphorous and potassium by cowpea compare to control and pig manure. 15tonha^{-1} of both organic manure improve more of root parameters and nutrients uptake These organic fertilizers provide essential nutrients, enhance nutrient availability in the soil, increase organic matter content, and improve soil structure. These studies referenced above demonstrate the positive effects of pig and poultry manure on cowpea root growth and nutrient uptake. Further studies are needed to fully understand the effects of organic manure on cowpea root growth parameters and nutrient uptake, and to develop effective management strategies for improving the productivity of cowpea production systems.

Journal of Agriculture and Food Sciences **Ogbuehi H.C and Emeribe E.O**
Volume 21, Number 2, October 2023, pp 177 - 190

REFRENCES

Abbasi, M.K., Mushtaq, A., & Tahir, M.M. (2009). Cumulative effects of white clover residues on the changes in soil properties, nutrient uptake, growth and yield of maize crop in the sub-humid hilly region of Azad Jammu and Kashmir, Pakistan. African *Journal of Biotechnoloy, 8*(10), 2184–2194

Abou El-Magd, M.A., El-Bassiony, M. & Fawzy, Z.F. (2006). Effect of organic manure with or without chemical fertilizer on growth, yield and quality of some varieties of Broccoli plants. *Journal of Applied Science Research, 2 (10):*791-798.

Adekiya, A.O., Agbede, T.M., & Ojeniyi, S.O. (2016). Effects of Poultry Manure and NPK Fertilizer on Soil Properties, Growth, and Yield of Cowpea. *Journal of Plant Nutrition*, *39*(11), 1564-1573.

Adewole, M.B., & Ilesanmi, A.O. (2011). Effects of soil amendments on the nutritional quality of okra (Abelmoschus esculentus [L.] Moench). *Journal of Soil Science and Plant Nutrition*, *11*(3), 45-55.

Akpa, E.E., Oke, E.O., & Adeyemi, O.A. (2017). Effect of farmyard manure and vermicompost on the growth and yield of cowpea (Vigna unguiculata L.) in Nigeria. *Journal of Sustainable Agriculture*, *40*(3), 355-370.

Akintoye, & Olaniyan, A.B. (2012). Yield of sweet corn in response to fertilizer sources. *Global Advance Research Journal of Agricultural Sciences, 1*(5): 110-116

Akinrinde, E.A., Ojeniyi, S.O., & Ojeniyi, E.O. (2017). Effect of Pig and Poultry Manures on Growth Performance of Cowpea (Vigna unguiculata L.) in Southwest Nigeria. *Journal of Agricultural Science, 9*(12), 1-8.

Anil Kumar Yadav, Ramawat Naleeni & Singh Dashrath (2019). Effect of organic manures and biofertilizers on growth and yield parameters of cowpea *(Vigna unguiculata (L.) Walp.) Journal of Pharmacognosy and Phytochemistry, 8*(2): 271-274

Ayoola, O. T., & Makinde, E. (2009). Maize growth, yield and soil nutrient changes with N-enriched organic fertilizers. *African Journal of Food, Agriculture, Nutrition and Development*, *9*(1), 580-592.

Carsky, R.J., Vanlauwe, B. & Lyasse, O. (2002). Cowpea rotation as a resource management technology for cereal-based systems in the savannas of West Africa. In: Fatokun CA, Tarawali SA, Singh BB, Kormawa PM, Tamo M (eds) Challenges and Opportunities for Enhancing Sustainable Cowpea Production. *International Institute of Tropical Agriculture, Ibadan, Nigeria,* 252-266.

Christoph, E**.** (2003). Sewage sludge and compost application in agriculture, and its effects on soil quality. Report on the consultancy stay on the occasion of the UNDP – RDA program: *Developing and Promoting Support System and International Cooperation on Environment – friendly Agriculture Suwon, Korea.*

Dademal, A.A., Dangale, J.H., & Mhaskar, N.V. (2004). Effect of manures and fertilizers content and uptake of nutrients by okra on laterilic soil of Konkan. *Journal of Soils and Crops*, *14*(2), 262-268.

Journal of Agriculture and Food Sciences
Volume 21, Number 2, October 2023, pp 177 - 190

Giller KE (2001). Targeting management of organic resources and mineral fertilizers: Can we match scientists' fantasies with farmers' realities? In: Vanlauwe B, Sanginga N, Diels J, Merckx R (eds) Balanced nutrient management systems for the moist Savanna and humid forest zones of Africa. *CAB International, Wallingford*

Giller KE, Cadisch G, Ehaliotis C, Adams E, Sakala WD, & Mafongoya PL (1997). *Building soil nitrogen capital in Africa. In: Buresh RJ, Sanchez PA (eds) Replenishing soil fertility in Africa. SSSA Special Publication 5, SSSA, Madison, WI, USA.*

Gupta, A, & Sharma, V.K.(2006) Studies on the effect of bio-fertilizer and phosphorus levels on yield and economics of Urdbean (*Vigna mungo* L. Hepper). *Legume Research*, 29, 278-281.

John, L.W., Jamer, D.B., Samuel, L.T., & Warner, L.W. (2004). Soil Fertility and Fertilizers: An Introduction to Nutrient Management, Pearson Education, India pp: 106–53.

Kumar, V., Sharma, R., & Sharma, A. (2018). Effect of vermicompost and farmyard manure on growth, yield and nutrient uptake of cowpea (Vigna unguiculata L.). *Journal of Environmental Science and Health,* PartB, 53,29-38

Pradeep, S.M., Deshpande, V.K., & Jagadeesh K.S. (2012). Evaluation of phytotoxicity of matured biocomposts obtained from pressmud and spentwash on seed germination and seedling vigour in different crops. *Research on Crops, 13*(2), 726-730.

Quilty JR and Cattle SR. (2011). Use and understanding of organic amendments in Australian agriculture: a review. *Australian Journal of Soil Research*, 49(1), 1-26.

Quin F (1997). Advances in Cowpea Research, Co-publication of international institute of Tropical Agriculture (IITA), Ibadan, Nigeria and Japan International Research Centre for Agricultural Sciences (JIRCAS), *Sayce Publishing, Devon, UK. Pp: ix – xv*

Nigeria Meteorological Organization (NIMET) (2010)

Mahetele, D. & Kushwaha, H.S. (2011). Productivity and profitability of pigeonpea as influenced by FYM, PSB and phosphorus fertilization under rainfed condition. *Journal of Food Legumes*, *24*(1):72-74

Ojeniyi, S.O., Akinrinde, E.A., & Ojeniyi, E.O. (2018). Effect of Pig and Poultry Manures on Nutrient Uptake and Yield of Cowpea (Vigna unguiculata L.) in Southwest Nigeria. *Journal of Agricultural Science, 10*(2), 1-9.

Oke, E. O., Adeyemi, O. A., & Akpa, E.E. (2017). Effect of organic manure and inorganic fertilizer on the growth and yield of cowpea (Vigna unguiculata L.) in Nigeria. *Journal of Agricultural Science, 9*(2), 105-116.

Sanginga, N., Dashiell, K.E., Diels, J., Vanlauwe, B., Lyasse, O., & Carsky, R.J. (2003). Sustainable resource management coupled to resilient germplasm to provide new intensive cereal–grain–legume–livestock systems in the dry savanna. *Agricultural Ecosystem Environment 100*:305-314

Senjobi, B.A., Peluola, C.O., Senjobi, C.T., Lawal, I.O., Ande, O.T., &Salami, B.T. (2010). Performance of Cochorus olitorius as influenced by soil type and organic manure

Journal of Agriculture and Food Sciences
Volume 21, Number 2, October 2023, pp 177 - 190

amendments in Yewa North Local Government Area, Ogun State. *African Journal of Biotechnology, 9*(33), 5309-5312

Shoko MD, Tagwira F,and Zhou M (2007). The potential of reducing nitrogen fertilizers in a soyabean-sugarcane production system in Zimbabwe. *African Journal of Agricultural Research 2, 16–26*

Tarawali SA, Singh BB, Gupta SC, Tabo R, Harris F, Nokoe S. (2002). Cowpea as a key factor for a new approach to integrated crop–livestock systems research in the dry savannas of West Africa. In: Fatokun CA, Tarawali SA, Singh BB, Kormawa PM, Tamo M (eds) Challenges and Opportunities for Enhancing Sustainable Cowpea Production. *International Institute of Tropical Agriculture, Ibadan, Nigeria,* 233-251

Tisdale SL, Havlin JL, Beaton DB, and Werner LN (1999). Soil fertility and fertilizers: an introduction to nutrient management, 6th edn. *Prentice Hall, New Jersey*

Timsina jagadish,(2018) Can Organic Sources of Nutrients Increase Crop Yields to Meet Global Food Demand**.** *Agronomy*, 8(10), 214

Udom, N. G., Fagam, A. S., & Bello, H. M. (2007). Effect of poultry litter on the yield of two maize varieties in the Nigerian savanna. *Continental Journal of Agronomy*, *1*, 18-24.

Waniyo U.U,M.M. Sauwa,1A.L. Ngala, G.A. Abubakar and E.C. Anelo(2013). Influence of Sources and Rates of Manure on Yield and Nutrient Uptake of Maize (Zea mays L.) in Maiduguri, Nigeria. *Nigerian Journal of Basic and Applied Science*, *21*(4): 259-265

Journal of Agriculture and Food Sciences
Volume 21, Number 2, October 2023, pp 177 - 190

APPENDICES

Table 1: Effect of Treatments on Number of Roots

Treatments	2WAP	4WAP	6WAP	8WAP	10WAP
$T_{1\text{-control}}$	5.000^{b}	11.500^{b}	18.500^{a}	23.750^{ab}	24.250^{b}
$T_{2\text{-10tns of pig manure}}$	8.500^{a}	15.500^{a}	17.500^{bc}	19.000^{ab}	27.250^{b}
$T_{3\text{-15tns of pig manure}}$	6.000^{ab}	12.000^{ab}	18.7500^{a}	27.500^{a}	30.250^{ab}
$T_{4\text{-10tns of poultry manure}}$	7.750^{ab}	11.750^{ab}	13.750^{c}	27.250^{a}	38.750^{a}
$T_{5\text{-15tns of poutry manure}}$	8.000^{a}	11.750^{ab}	13.250^{b}	22.500^{a}	24.500^{b}

Mean in the column, having the same letter(s) are not significantly different at P≤0.05, according to Least Significant Difference (LSD) method.

Table 2: Effect of Treatment on Root Length of Cowpea

Treatments	2WAP	4WAP	6WAP	8WAP	10WAP
$T_{1\text{-control}}$	3.6750^{a}	6.1500^{a}	10.9750^{a}	14.4000^{a}	18.550^{b}
$T_{2\text{-10tns of pig manure}}$	3.1250^{a}	6.4750^{a}	11.1750^{a}	14.8000^{a}	20.375^{ab}
$T_{3\text{-15tns of pig manure}}$	4.0000^{a}	7.4250^{a}	11.4250^{a}	15.7000^{a}	21.925^{ab}
$T_{4\text{-10tns of poultry manure}}$	3.1750^{a}	7.0750^{a}	11.7250^{a}	14.6500^{a}	20.850^{a}
$T_{5\text{-15tns of poutry manure}}$	3.7250^{a}	7.4750^{a}	10.8250^{a}	14.7000^{a}	21.950^{a}

Mean in the column, having the same letter(s) are not significantly different at P≤0.05, according to Least Significant Difference (LSD) method.

Table 3: Effect of Treatment on Number of Root Nodules

Treatments	2WAP	4WAP	6WAP	8WAP	10WAP
$T_{1\text{-control}}$	-	-	0.7500^{a}	3.7500^{a}	6.0000^{a}
$T_{2\text{-10tns of pig manure}}$	-	-	1.5000^{a}	4.5000^{a}	7.2500^{a}
$T_{3\text{-15tns of pig manure}}$	-	-	2.0000^{a}	4.0000^{a}	7.2500^{a}
$T_{4\text{-10tns of poultry manure}}$	-	-	1.2500^{a}	3.5000^{a}	7.5000^{a}
$T_{5\text{-15tns of poutry manure}}$	-	-	1.2500^{a}	3.7500^{a}	6.5000^{a}

Mean in the column, having the same letter(s) are not significantly different at P≤0.05, according to Least Significant Difference (LSD) method.

Journal of Agriculture and Food Sciences
Volume 21, Number 2, October 2023, pp 177 - 190

Table 4: Effect of Treatment on Root Dry Matter(g)

Treatments	2WAP	4WAP	6WAP	8WAP	10WAP
$T_{1\text{-control}}$	1.0400^{d}	1.3665^{e}	2.5623^{e}	3.6765^{e}	4.3215^{e}
$T_{2\text{-10tns of pig manure}}$	0.9303^{e}	1.8303^{d}	3.4788^{d}	5.7700^{c}	7.625^{c}
$T_{3\text{-15tns of pig manure}}$	1.7368^{c}	2.2123^{c}	4.3075^{c}	4.8895^{d}	5.7213^{d}
$T_{4\text{-10tns of poultry manure}}$	2.0568^{a}	3.2890^{b}	5.8493^{b}	6.1313^{b}	8.2333^{b}
$T_{5\text{-15tns of poutry manure}}$	1.9083^{b}	4.0828^{a}	6.4988^{a}	8.8375^{a}	9.105^{a}

Mean in the column, having the same letter(s) are not significantly different at P≤0.05, according to Least Significant Difference (LSD) method

Table 5: Effect of Treatments on Nitrogen Uptake

Treatments	2WAP	4WAP	6WAP	8WAP	10WAP
$T_{1\text{-control}}$	0.01875^{e}	0.02425^{c}	0.0490^{e}	0.11875^{e}	0.21675^{d}
$T_{2\text{-10tns of pig manure}}$	0.2475^{d}	0.05475^{bc}	0.11175^{d}	0.23775^{c}	0.5850^{a}
$T_{3\text{-15tns of pig manure}}$	0.0405^{c}	0.07125^{b}	0.12875^{c}	0.23575^{d}	0.37025^{d}
$T_{4\text{-10tns of poultry manure}}$	0.059^{a}	0.085^{b}	0.1915^{b}	0.30375^{c}	0.4675^{c}
$T_{5\text{-15tns of poutry manure}}$	0.05675^{b}	0.12325^{a}	0.3135^{a}	0.4105^{a}	0.5680^{b}

Mean in the column, having the same letter(s) are not significantly different at P≤0.05, according to Least Significant Difference (LSD) method.

Table 6: Effect of Treatment on Phosphorus Uptake

Treatments	2WAP	4WAP	6WAP	8WAP	10WAP
$T_{1\text{-control}}$	3.5605^{e}	6.2823^{e}	13.68350^{e}	21.4658^{e}	31.1560^{e}
$T_{2\text{-10tns of pig manure}}$	4.0365^{d}	10.8778^{d}	27.66930^{d}	45.785^{c}	61.8348^{c}
$T_{3\text{-15tns of pig manure}}$	9.0198^{c}	13.695^{c}	35.8168^{c}	40.0255^{d}	50.6185^{d}
$T_{4\text{-10tns of poultry manure}}$	10.9925^{b}	22.763^{b}	51.067^{b}	58.343^{a}	75.2848^{b}
$T_{5\text{-15tns of poutry manure}}$	11.3675^{a}	29.2785^{a}	44.1143^{b}	77.308^{a}	88.8078^{a}

Mean in the column, having the same letter(s) are not significantly different at P≤0.05, according to Least Significant Difference (LSD) method.

Journal of Agriculture and Food Sciences
Volume 21, Number 2, October 2023, pp 177 - 190

Table 7: Effect of Treatments on Potassium Uptake

Treatments	2WAP	4WAP	6WAP	8WAP	10WAP
$T_{1\text{-control}}$	0.0823^{e}	0.160^{e}	0.3588^{e}	1.659^{e}	2.6968^{e}
$T_{2\text{-10tns of pig manure}}$	0.1508^{d}	0.433^{d}	0.9338^{d}	2.854^{b}	5.444^{b}
$T_{3\text{-15tns of pig manure}}$	0.4138^{c}	0.674^{c}	1.3528^{c}	2.485^{c}	4.3183^{c}
$T_{4\text{-10tns of poultry manure}}$	0.5798^{b}	1.117^{b}	1.8915^{d}	1.8915^{d}	4.3183^{c}
$T_{5\text{-15tns of poutry manure}}$	0.621^{a}	1.5103^{a}	2.6923^{a}	5.4563^{a}	7.3908^{a}

Mean in the column, having the same letter(s) are not significantly different at $P \leq 0.05$, according to Least Significant Difference (LSD) method.