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Influence Of Organic and Inorganic Fertilizers on the Production of Cowpea (*Vigna unguiculata*) in Taraba State, Nigeria

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Abstract

The study was carried out to examine the influence of organic and inorganic fertilizers on the production of cowpea (*Vigna unguiculata)* in Taraba State, Nigeria. The specific objectives of the study were among other things, to determine the influence of organic and inorganic fertilizers on the growth rate and yield of cowpea. Three (3) research questions were posed and answered by the study while three (3) null hypotheses were formulated and tested at 0.05 level of significance. Survey research design was used for the study and the study was conducted in Taraba State. The population of the study was two hundred and ninety-one (291) cowpea farmers. The sample for the study was one hundred and sixty-eight (168) respondents comprising sixty (60) organic cowpea farmers and one hundred and eight (108) inorganic cowpea farmers which were obtained using Taro-Yamen's formula. The instrument for data collection was a 17-item structured questionnaire. The instrument was validated by three experts. A reliability coefficient of the instrument was .89 which was obtained using Cronbach-Alpha reliability method. The instrument was administered to the respondents on their farm fields with the help of three (3) research assistants. Mean and standard deviation was used to answer research questions while the hypotheses were tested using t-test at 0.05 level of significance. The findings of the study revealed that at maturity, cowpea produced between 15-35 leaves and has about 3-5 branches. It was equally discovered from the study that, cowpea yield an average of between 400 – 800kg/ha. It was concluded that both organic and inorganic fertilizers when adequately applied using appropriate methods of application can enhance the growth and yield of cowpea.

Keywords: Influence, fertilizers, growth, yield, cowpea

INTRODUCTION

The quest for human survival has made man to cultivate many food crops including cowpea. Cowpea (*Vigna unguiculata*) is an annual leguminous crop that is widely cultivated in Nigeria especially the savannah areas for the purpose of consumption by both humans and animals. According to Ogaraku (2007), the young succulent leaves of cowpea plants are eaten as vegetables, which form an important source of cheap vegetable containing about 25% protein. Cowpea is consumed by both animal and humans and is grown in the semi-arid tropics covering Africa, Asia, Europe, United States, Central and South America (International Institute for Tropical Agriculture; IITA, 2009). It is a legume grown in savannah region, the tropics and sub-tropics. It is largely grown in the West and Central African countries (Adeoye *et al.,* 2011).

Report by IITA (2009) revealed that, more than 5.4 million tons of dry cowpeas are produced worldwide, with Africa producing nearly 5.2 million. Nigeria, the largest producer and consumer, accounts for 61% of production in Africa and 58% worldwide. The report further indicate that, fifty-two percent (52%) of Africa's production is used for food, thirteen percent (13%) as animal feed, ten percent (10%) for seeds, nine percent (9%) for other uses, and sixteen percent (16%) is wasted. According to Ogaraku (2007), cowpea seeds have protein digestibility value of 86 – 90% and rank among

the highest for major legumes.

Ordinarily, Cowpea, been a leguminous crop with the potential of fixing nitrogen into the soil will require little or no nitrogen from other sources whether organic or inorganic. However, with the depletion in soil mineral nutrient which is occasioned by continuous cropping of the land, cowpea equally requires the provision of additional soil nutrient elements to yield maximally. Sharma *et al.* (2015) reported that, cowpea, being a leguminous crop may not need much nitrogen, but at initial stage in the young plants before nodulation stage, deficiency may exhibit and it may suffer due to nitrogen starvation, hence small amount of inorganic nitrogen may stimulate early seedling growth and nodulation, leading to an increase in the amount of nitrogen fixed by the plant.

Organic fertilizers covers manures made from cattle dung, excreta of other animals, rural and urban waste, composts, other animal wastes, crop residues and green manure (Nwaiwu *et al.,* 2010). Organic manure are known for their ability to improve the soil physical, chemical and biological properties which can result to better growth and higher crop yield. Adeoye *et al.* (2011) assert that, the beneficial effects of animal manure on soil physical properties and the ease with which they decompose inside soil are major advantages they have over inorganic fertilizers.

In recent times, many people have advocated an integrated approach involving a combination of both organic and inorganic fertilizers. Sharma *et al.* (2015) submit that, to maintain the soil fertility and to supply plant nutrients in balanced proportion for optimum growth, yield and quality of crop, integrated approach is to be practiced under specific agroecological situation through the combined use of inorganic and organic sources of plant nutrients.

Inorganic fertilizers according to Pinell (2015) are classified as those fertilizers that are synthesized or mined from non-living materials. Also known as chemical fertilizers, inorganic fertilizers are considered quick-release fertilizers; that is, the rate at which fertilizers release nutrients for the plant to absorb is relatively fast. However, too much application of inorganic fertilizer results to many problems. According to Itelima *et al.* (2015), intensive application of agrochemicals lead to several agricultural problems and poor cropping systems. Similarly, Agbulu and Elaigwu (2013) submit that, some pesticides and their residues can result in chronic and acute poisoning, carcinogenicity, mutagenicity and reproductive defects.

Despite the negative effects on the soil and the environment generally, the application of inorganic fertilizers using different methods has remained a viable option in crop production especially in emergency situations as they have the necessary nutrients that are essential for plant growth and survival. Both organic and inorganic fertilizers have great influence on the productivity of cowpea. There is need therefore, for a comparative study to assess the influence of these fertilizers on the growth and yield of cowpea.

Statement of the Problem

Agriculture is better described as the bedrock of a nation's economy as it has the potentials for both food production and economic diversification. The current effort by the federal government of Nigeria to diversify the economy through agriculture and solid mineral development is a right step in the right direction. Nigeria has large arable land that supports food crop production including cowpea. However, because of the practice of continuous cropping occasioned by population growth without a corresponding increase in arable land mass, there is a decline in the yield of food crops including cowpea. This suggests the need for a comparative study of the influence of organic and inorganic fertilizers on the growth and yield of cowpea to ascertain the most viable and cost effective alternative for a profitable and sustainable cowpea production in Taraba State.

Purpose of the Study

The purpose of this study was to examine the influence of organic and inorganic fertilizers on the growth and yield of cowpea. Specifically, this research sought to:

1. examine the methods of application of organic and inorganic fertilizers for maximum cowpea production in Taraba State.
2. determine the influence of organic and inorganic fertilizers on the growth rate of cowpea in Taraba State
3. examine the influence of organic and inorganic fertilizers on the yield of cowpea in Taraba State

Research Questions

1. What are the methods of application of organic and inorganic fertilizers for maximum cowpea production in Taraba State?
2. What is the influence of organic and inorganic fertilizers on the growth rate of cowpea in Taraba State?

3. What is the influence of organic and inorganic fertilizers on the yield of cowpea in Taraba State?

Research Hypotheses

1. There is no significant difference in the mean ratings of organic and inorganic farmers on the methods of application of organic and inorganic fertilizers.
2. There is no significant difference in the mean ratings of organic and inorganic farmers on the growth rate of cowpea.
3. There is no significant difference in the mean ratings of organic and inorganic farmers on the yield of cowpea.

Methodology

The research design adopted by this study was survey design. The design was considered appropriate for this study since data was collected from a large sample which is a representative of the total population using questionnaire. The study was conducted in Taraba State. The study area is one of the thirty-six (36) states of Nigeria. The major occupation of the people of the State is farming. The population of the study was two hundred and ninety-one (291) cowpea farmers who participated in the year 2014 Crop Yield/Area Survey (CYAS) which was conducted by Taraba Agricultural Development Programme, TADP, Jalingo. The sample for this study was one hundred and sixty-eight (168) respondents obtained using Taro-Yamen's formula. The sample comprised of sixty (60) organic cowpea farmers and one hundred and eight (108) inorganic cowpea farmers. Multi-stage sampling technique was adopted for this study. In the first stage, purposive sampling technique was used to select six (6) local government areas of the state. Secondly, simple random sampling technique was used to select ten (10) organic and eighteen (18) inorganic cowpea farmers from each of the six (6) local government areas. Simple random sampling was used because it gives each element of the population equal and independent chance of being included in the sample.

The instrument for data collection was a 17-item structured questionnaire titled "Organic and Inorganic Fertilizer Cowpea Production Questionnaire (OIFCPQ)" developed from literature review. The instrument covers information on the methods of application of organic and inorganic fertilizers for cowpea production, effect of organic and inorganic fertilizers on the growth rate of cowpea and effect of organic and inorganic fertilizers on the yield of cowpea which were responded to by both organic and inorganic cowpea farmers. The items have a four-point response option as: Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). The response options also have a corresponding rating of 4, 3, 2 and 1 respectively. The instrument was validated by three experts; two from Department of Vocational Agriculture and Technology Education, College of Agricultural and Science Education and one from Department of Crop Production, College of Agronomy, all of Federal University of Agriculture, Makurdi. A reliability coefficient of .89 was obtained using Cronbach-Alpha reliability method.

The instrument was administered to the respondents on their farm fields with the help of three (3) research assistants. The research assistants were trained on how to administer and retrieve the instrument. One hundred and sixty-eight (168) copies of the questionnaire were administered on the respondents in all. All administered questionnaire were retrieved and analyze. Mean and standard deviation was used to answer research questions. Any item with a mean value of 2.50 and above was regarded as agreed whereas any item with a mean value less than 2.50 was regarded as not agreed. The hypotheses were tested using t-test at 0.05 level of significance. The hypothesis of no significant difference was rejected where the t-calculated value exceeds the t-tabulated value at 0.05 level of significance while the hypothesis of no significant difference was not rejected where the t-calculated value is less than the t-tabulated value at 0.05 level of significance.

Results and Discussion

The results of the study were obtained from the research questions answered and hypotheses tested through data collected and analyzed.
The data for answering research questions and testing hypotheses are presented, interpreted and discussed in Tables 1 to 3 as follows:

Research Question 1

What are the methods of application of organic and inorganic fertilizers for maximum cowpea production in Taraba State?

Hypothesis 1

There is no significant difference in the mean ratings of organic and inorganic farmers on the methods of application of organic and inorganic fertilizers

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Table 1. Mean, Standard Deviation and t-test analysis of Respondents on methods of application of organic and inorganic fertilizers for maximum Cowpea Production in Taraba State (N= 168; n_1=108 Inorganic Farmers and n_2=60 Organic Farmers)

S/N	Application methods	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}_g$	SD_g	t-cal	t-crit	Remark
1.	Broadcasting	3.56	.49	3.80	.40	3.65	.47	2.40	1.96	**
2	Deep soil application	2.90	.49	3.20	.40	3.01	.48	3.00	1.96	**
3	Banding	1.82	.38	2.80	.40	2.17	.60	9.80	1.96	**
4	Liquid application	3.07	1.13	3.00	.00	3.05	.90	0.70	1.96	*NS
5	Fertigation	1.16	.49	1.00	.00	1.39	.49	2.66	1.96	**
6	Pellet application	1.50	.63	2.00	.63	1.68	.67	4.16	1.96	**

N= number of respondents, $\bar{X}_1$= mean of inorganic farmers, SD_1= standard deviation of inorganic farmers, $\bar{X}_2$= mean of organic farmers, SD_2 = standard deviation of organic farmers, $\bar{X}_g$= grand mean of respondents SD_g = grand Standard deviation of respondents, t-cal=t-calculated, t-crit=critical value, **=significant and rejected,*NS=Not significant and Not Rejected.

Data in Table 1 revealed that 3 items on application method had their grand mean values ranged from 3.01 to 3.65, indicating that their mean values were above the cut-off point of 2.50. This shows that the 3 items were methods of application of organic and inorganic fertilizers for maximum cowpea production in Taraba State. Similarly, the other 3 items had their grand mean values ranged from 1.39 to 2.17 which showed that these 3 methods are not used in the application of organic and inorganic fertilizers for maximum cowpea production in Taraba State. The Table also showed that the grand standard deviation of the items ranged from .47 to .90, indicating that the respondents were not too far from the mean and from the opinion of one another in their responses on the methods of application of organic and inorganic fertilizers for maximum cowpea production in Taraba State.

The table further indicated that, the t-calculated value of 5 items ranged from 2.40 to 9.80 which were greater than the t-critical value of 1.96 at 0.05 level of significance. This implied that there was statistical significance difference in the mean ratings of organic and inorganic farmers on the methods of application of organic and inorganic fertilizers. Therefore, the null hypothesis was rejected. This further imply that the experience of organic and inorganic farmers significantly differ on the methods of application of organic and inorganic fertilizers in Taraba state. The findings in table 1 agrees with TNAU (2014) who lists the different methods of fertilizer application as broadcasting, placement, drilling, side dressing, pellet application, foliar application and fertigation.

Research Question 2

What is the influence of organic and inorganic fertilizers on the growth rate of cowpea in Taraba State?

Hypothesis 2

There is no significant difference in the mean ratings of organic and inorganic farmers on the growth rate of cowpea.

Data in Table 2 revealed that all the 5 items on growth rate of cowpea had their grand mean values ranged from 2.63 to 3.59, indicating that their mean values were above the cut-off point of 2.50. This shows that all the 5 items represents the influence of organic and inorganic fertilizers on the growth rate of cowpea in Taraba State. The Table also showed that the grand standard deviation of the items ranged from .49 to 1.24, indicating that the respondents were not too far from the mean and from the opinion of one another in their responses on the influence of organic and inorganic fertilizers on the growth rate of cowpea in Taraba State. The table further indicated the t-calculated value ranged of 3.30 to 15.16 which were greater than the t-critical value of 1.96 at 0.05 level of significance. This implied that there was statistical significance difference in the mean ratings of organic and inorganic farmers on the growth rate of cowpea. Therefore, the null hypothesis was rejected. This further imply that the experience of organic and inorganic farmers significantly differ on the growth rate of cowpea upon application of organic and inorganic fertilizers in Taraba state.
Furthermore, in Table 2, it was discovered that, both organic and inorganic cowpea farmers agreed that at maturity,

Table 2. Mean, Standard Deviation and t-test analysis of Respondents on influence of organic and inorganic fertilizers on the growth rate of cowpea in Taraba State (N= 168; n_1=108 Inorganic Farmers and n_2=60 Organic Farmers)

S/N	Items statement	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}_g$	SD_g	t-cal	t-crit	Remark
7.	At maturity, cowpea have between 15-35 leaves per plant	3.36	.48	4.00	.00	3.59	.49	10.66	1.96	**
8	At maturity, each plant has about 3-5 branches	3.53	.50	3.20	.40	3.41	.49	3.30	1.96	**
9	At flowering, a cowpea plant produces between 10-19 flowers	1.98	1.06	3.80	.40	2.63	1.24	15.16	1.96	**
10	At maturity, a cowpea plant produces about 7-21 pods per plant	2.70	.75	3.20	.40	2.88	.69	4.54	1.96	**
11	At maturity, cowpea form a total cover of the soil	3.54	.50	1.60	.80	2.85	1.12	14.92	1.96	**

N= number of respondents, $\bar{X}_1$= mean of inorganic farmers, SD_1= standard deviation of inorganic farmers, $\bar{X}_2$= mean of organic farmers, SD_2 = standard deviation of organic farmers, $\bar{X}_g$= grand mean of respondents SD_g = grand Standard deviation of respondents, t-cal=t-calculated, t-crit=critical value, **=significant and rejected,*NS=Not significant and Not Rejected.

cowpea produced between 15-35 leaves and has about 3-5 branches. This is in agreement with Taura and Fatima (2008) who report that with the application of organic manure, cowpea produces a total number of 17 leaves. However, at flowering stage, there was a disagreement between organic and inorganic farmers as organic farmers agreed that at flowering, a cowpea plant produces between 10 – 19 flowers whereas, the inorganic farmers disagreed. There was also a consensus between organic and inorganic farmers that at maturity, a cowpea plant produces about 7-21 pods per plant. This agrees with Adeoye *et al.* (2011) who report that, on average, a plot of cowpea fertilized with cow dung produces 14 pods per plant, poultry droppings produces 22 pods per plant while a combination of cow and poultry manure produces 17 pods per plant. There was equally a disagreement when inorganic cowpea farmers agreed that at maturity, cowpea forms a total cover of the soil whereas the organic farmers disagreed

Research Question 3

What is the influence of organic and inorganic fertilizers on the yield of cowpea in Taraba State?

Hypothesis 3

There is no significant difference in the mean ratings of organic and inorganic farmers on the yield of cowpea

Table 3. Mean, Standard Deviation and t-test analysis of Respondents on influence of organic and inorganic fertilizers on the yield of cowpea in Taraba State (N= 168; n_1=108 Inorganic Farmers and n_2=60 Organic Farmers)

S/N	Items statement	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}_g$	SD_g	t-cal	t-crit	Remark
12	<400kg of cowpea/ha	3.31	1.13	3.60	.80	3.41	1.03	12.60	1.96	**
13.	400 – 500kg of cowpea/ha	3.29	.51	3.00	.00	3.18	.43	4.26	1.96	**
14	500 – 600kg of cowpea/ha	2.17	.81	2.60	.49	2.32	.74	3.58	1.96	**
15	600 – 700kg of cowpea/ha	2.13	1.12	2.20	.40	2.15	.93	0.58	1.96	*NS
16	700 – 800kg of cowpea/ha	2.66	1.26	2.00	.63	2.42	1.12	4.71	1.96	**
17	>800kg of cowpea/ha	2.59	1.38	1.60	1.21	2.24	1.40	5.50	1.96	**

N= number of respondents, $\bar{X}_1$= mean of inorganic farmers, SD_1= standard deviation of inorganic farmers, $\bar{X}_2$= mean of organic farmers, SD_2 = standard deviation of organic farmers, $\bar{X}_g$= grand mean of respondents SD_g = grand Standard deviation of respondents, t-cal=t-calculated, t-crit=critical value, **=significant and rejected,*NS=Not significant and Not Rejected.

Data in Table 3 revealed that 2 items on the yield of cowpea had their grand mean values ranged from 3.18 to 3.41, indicating that their mean values were above the cut-off point of 2.50. This shows that the 2 items were the yield obtained from cowpea upon application of organic and inorganic fertilizers in Taraba State. Similarly, the other 4 items had their grand mean values ranged from 2.15 to 2.42 which showed that these 4 ranged of yield are not obtainable in cowpea upon application of organic and inorganic fertilizers in Taraba State. The Table also showed that the grand

standard deviation of the items ranged from .43 to 1.40, indicating that the respondents were not too far from the mean and from the opinion of one another in their responses on the the influence of organic and inorganic fertilizers on the yield of cowpea in Taraba State. The table equally revealed that 5 items had their t-calculated value ranged from 3.58 to 12.60 which were greater than the t-critical value of 1.96 at 0.05 level of significance. This implied that there was statistical significance difference in the mean ratings of organic and inorganic farmers on the yield of cowpea. Therefore, the null hypothesis was rejected. This further imply that the experience of organic and inorganic farmers significantly differ on the yield of cowpea upon application of organic and inorganic fertilizers in Taraba state.

In table 3, both organic and inorganic cowpea farmers hold diverse opinions. Organic farmers agreed that cowpea yield about 600kg/ha whereas, inorganic farmers agreed that cowpea yield about 800kg/ha or even more. The findings of this study is however in contrast with Reyhan and Amiraslani (2006) who report a cowpea yield of about 854kg/ha from plot treated with poultry manure. Similarly, Nwaiwu *et al.* (2010) also observed a mean yield of cowpea of 744.7kg/ha on soils treated with poultry manure. In their opinion, Abayomi *et al.,* (2008) report that the application of NPK fertilizer on cowpea resulted in significant improvement in plant height, number of leaves and significantly enhanced the yield of cowpea.

Conclusion

Agricultural sector is critical to the development of the Nigeria's economy. Nigeria has great potentials for crop production including cowpea. Cowpea is important both to man and animals. However, the production of cowpea in Nigeria is bedevilled with alot of problems including poor soil fertility due to continuous cropping. Based on the findings of this study, it was concluded that both organic and inorganic fertilizers when adequately applied using different methods can enhance the growth and yield of cowpea.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. Agricultural Extension agents should educate cowpea farmers on the various methods of fertilizer application in cowpea especially those methods that are simple but effective.
2. Cowpea farmers should ensure timely application of fertilizers for maximum production.

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