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Growing *Amaranthus* as a Means of Livelihood among Peasant Farmers in Africa

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Authors' contributions

This work was carried out in collaboration between all authors. Author LSA designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors EAOD and ADO managed the analyses of the study. Author KJO managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Nigeria soils are depleted as a result of mismanagement, hence, the peasant farmers experience low yield which scares the youths from taking farming as their profession. For any meaningful transformation to occur, the youth must be involved, well fed with a balanced diet that can keep them healthy and energetic. The objectives of this study were to determine the effects of poultry manure and cattle dung on soil chemical properties, growth and yield of *Amaranthus cruentus*, in order to increase production of Amaranthus as well as manitaining soil fertility Two experiments, were conducted in 2015 to determine the effect of poultry manure (PM) and cattle dung (CD) on growth parameters of *Amaranthus cruentus* in Ondo southwestern Nigeria. Poultry manure and cattle dung were each applied at 0, 5, 10, 15 and 20 t/ha. The treatments were arranged in a randomised complete block design with three replications. Relative to control, application of PM at all rates and CD at 10, 15 and 20 t /ha significantly ($p > 0.05$) increased plant height, number of leaves, leaf area and leaf fresh weight. Poultry manure increased the agronomic parameters of *Amaranthus cruentus* as the rate of manure increased.

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Keywords: Poultry manure; cattle dung; agronomic parameters; soil.

1. INTRODUCTION

Many African children suffer from sicknesses and diseases such as kwarshoikor as a result of malnutrition. Old people are faced with different types of chronic diseases such as diabetes, heart attack due to insufficient balanced nutrition and unfavourable eating habit. Many sicknesses and diseases could be averted if vegetables are included in Africans dietary formulation.

Vegetables perform vital roles in the human diet [1]. Most vegetables and fruits such as *Basella alba*, Amaranthus spp, waterleaf, eggplant, pumpkin and host of others play significant roles in reducing or preventing the deadly diseases [2]. Vegetables can replace some drugs if it becomes part of African diets.

Many researchers have argued that vegetables grown with organic fertilisers are more nutritious and provide a healthy condition to the body compared with the vegetables grown with mineral fertilisers [3]. The increase in the cost of mineral fertilisers has led the subsistence farmers into growing of vegetables with organic wastes like poultry manure, cattle dung, pig dung and compost manures. Growing of vegetables with animal wastes will reduce environmental pollution, increase in crop yield and enhance soil sustainability for crop production. Geier, [4] argued that organically produced foods have no harming effect.

Poultry manure and cattle dung are the two significant animal wastes that are common in Nigeria. Poultry manure is found in many areas of southern Nigeria while cattle dung is common in the northern part of Nigeria. Utilization of poultry and cattle manures as fertilisers in areas where they are prevalent will increase crop production across Nigeria and hence, reduce the level of poverty among the citizens.

Many African youths are not into agriculture as a profession because they believe that agriculture is not lucrative and that people into agriculture are mere unrecognised poor people in the society who have no tangible academic qualification that would fetch them white collar job. Increase in the yield of crops with minimum cost will lead to increase in money realized from farming and thus will attract the youths into agricultural businesses.

In order to achieve transformation in Africa, efforts must be geared toward harnessing locally available materials, cheap and environmental friendly for crop production. In crop production, plant nutrients could be got from poultry manure and cattle dung. They are cheap, readily available and environmentally feasible. Research works have shown that poultry manure and cattle dung contain the reasonable amount of plant nutrients [5]. *Amaranthus cruentus* is a staple vegetable, cheap and has short and can be harvested within one month after sowing. The objectives of this study were to determine the effects of poultry manure and cattle dung on soil chemical properties, growth and yield of *Amaranthus cruentus* in Ondo southwestern Nigeria.

2. MATERIALS AND METHODS

Two field experiments were carried out at the Teaching and Research Farm of Adeyemi College of education, Ondo south west Nigeria between March and April, 2014 to compare the effect of poultry manure and cattle dung on soil chemical properties, growth and yield of *Amaranthus cruentus*. The two experiments were concurrently carried out at two different locations within the Research Farm.

Ondo lies in latitude 7º04'13,93", longitude 4º49'05,97" E and at elevation 381.3 m asl [6]. Fresh poultry dung was collected from poultry house while cattle dung was collected from abbatoir in Ondo. The fresh manures were cured for two weeks before application. Amaranthus seeds were bought from the Ondo State Agricultural Development Project, Ondo, Nigeria .

The lands were cleared, pegged and made into 4m x4m ridges with a discard area of 0.5 m. The experiment was laid out in randomized complete block design and replicated three times. Poultry manure and cattle dung were separately applied at 0, 5, 10, 15 and 20 t/ha. The treatments were applied to the soil two weeks before planting. Amarantus was broadcast on each plot and thinned 30 plants per plot. Weeding was done at two weeks interval.

The initial and final soil analyses were carried out to determine the number of plant nutrients present in the soil before the experiment and then determined the residual effect of poultry manure and cattle dung after the harvest of Amaranthus. Soil samples were randomly collected, bulked, air dried and sieved through 2

mm mesh for initial analysis while soil samples were collected per plot in final analysis. The pH of the two soils was determined in 1:2 soil-water ratio. Organic carbon was determined by Walkely and Dichromate Oxidation Method, total nitrogen was determined by Mickrockjedahl method and available phosphorus was extracted with Bray – 1 – method and determined colourimetrically. Exchangeable potassium, Calcium and Magnesium were extracted with neutral ammonium acetate and determined by Atomic Absorption Spectrophotometer (AAS).

Five *Amaranthus* plants were tagged per plot for data collection. Data were collected on number of leaves, plant height, leaf area, moisture content and leaf weight. The number of leaves were counted, plant height was measured from the base of the plant to the terminal bud while the leaf area was determined by graphical method. The leaves were removed and placed on the graph paper and the whole square occupied by the leaf surface were counted. The freshly harvested plants were oven dried at 65ºC until the weight was constant.

The shoot was weighed with a weighing balance.

2.1 Statistical Analysis

The mean data for the experiment sited in different location within the Research Farm were generated and analysed. Analysis of variance was performed and the data were separated with Duncan Multiple Range Test at 5%.

3. RESULTS AND DISCUSSION

The soil properties of the two sites used for the experiment are shown in Table 1. The soils were acidic, low in organic matter, total nitrogen and available phosphorus. This shows that the soils were deficient in the three most important nutrients required for optimum crop production. Nitrogen is required for vegetative growth i.e. increase in plant height, leaf area and green colouration of the leaves. Consumers wish to buy the vegetables that are fresh and succulent with broad leaves. This means for vegetable like amaranthus to attain marketable value, the soil which it is being grown must be rich in N. Phosphorus is needed for phosphorylation and root elongation while K is needed for water uptake and carbohydrate synthesis. There must be balanced plant nutrition in the soils grown with amaranthus to ensure optimum growth and yield.

Table 1. Initial soil properties

Soil properties	1	2
pH	5.1	5.3
OM%	2.19	2.2
N%	0.09	0.08
Available P mg/kg	3.89	4.23
Ca C mol/kg	2.21	2.21
Mg C mol/kg	1.94	1.98
K C mol/kg	0.12	0.14

The poultry manure and cattle dung used to grow *Amaranthus* in this experiment showed clearly that poultry manure had higher N, P, K, Ca and Mg with lower C/N ratio compared with cattle dung. The implication was that poultry manure used in the experiment was likely to release more plant nutrients to the soil for *Amaranthus* uptake than cattle dung. Many research works have shown that poultry manure and cattle dung contain plant nutrients that could be used to increase the nutrient status of depleted soils [7].

Table 2. Nutrient composition of poultry manure and cattle dung

Nutrient %	Cattle dung	Poultry manure
OC	37.3	15
Nutrient%	1.19	2.13
CN	31	7.14
P	0.31	4.5
K	0.47	3.9
Ca	2.61	2.8
Mg	0.59	0.42

Effect of poultry manure and cattle dung on the growth and yield of amaranthus is shown in Table 3. Compared to control, all the treatments significantly increased ($p<0.05$) plant height, number of leaves and leaf fresh weight of amaranthus compared with cattle dung. The increase in the growth and yield parameters of amaranthus over the control might be as a result of the addition of poultry manure and cattle dung to the plants. Makinde et al. [8] stated that animal manures are good sources of plant nutrients. Ayeni et al. [9] affirmed that animal manures especially poultry manure are sources of plant nutrients such as N, P, K, Ca and Mg and some micronutrients in the experiment conducted to show the effect of poultry manure and cocoa pod ash on the growth and yield of tomato in

Table 3. Mean effect of poultry manure and cattle dung on growth and yield of *Amaranthus cruentus*

Treatments	Plant height	No of leaves	Leaf area	Fresh leaf weight	Dry matter
Control	20.21d	12.00f	13.61d	22.04e	6.01c
5PM	22.33d	12.67f	14.63d	22.33e	6.04c
10PM	46.40b	37.00d	50.82b	36.00c	13.06b
15PM	73.33a	83.00b	88.77a	61.77b	17.10a
20PM	84.55a	96.33a	97.00a	72.45a	18.08a
5CD	21.21d	46.73f	14.78d	20.63e	6.02c
10CD	46.73b	15.23e	39.95c	27.42d	6.19c
15CD	49.23b	17.38e	39.97c	27.77d	6.17c
20CD	35.73c	17.14e	36.99c	24.93d	6.18c

Means with the same letter are not significantly different at 5% DMRT

Southwestern Nigeria. The better performance of poultry manure over cattle dung might be as a result of higher plant nutrients supplied to the plant than cattle dung. This could be buttressed by the fact that as the rate of poultry manure that was applied increased, so the agronomic parameters of *Amaranthus* increased. This finding is in line with the work of Macrere [10] who affirmed that poultry manure, goat dung and cow dung significantly increased the growth and yield of *Amaranthus* at different rates of application. It was observed that application of cattle dung at 20 t/ha reduced the growth and yield of *Amaranthus*. This might be a result of high C/N ratio compared with poultry manure. Records have shown that the higher the C/N ratio, the lower the rate of nutrients release because it will be resistant to degradation by micro-organisms.; thus immobilisation of plant nutrients. The large quantity of cattle dung (20 t/ha) might be too much for the available microorganisms to degrade.

Table 4 showed the residual effect of poultry manure and cattle dung on soil chemical characteristics after the harvest of *Amaranthus*. Compared to control, application of 10, 15 and 20 t/ha of PM significantly increased ($p<0.05$) soil pH showing that poultry manure could be used as liming material in acidic soils. Cattle dung had no significant effect on the pH of the soil used for the experiment. Though, many researchers affirmed that cattle dung increases soil pH, this experiment showed that it is not in all cases. The effect of animal dungs on plant and soil chemical properties depend on C/N ratio, the age of the animal, the type of feeds given to the animal, environmental condition of the place the manure is cured, moisture content of the manure and the quantity of the manure applied to the plant [11]. All the treatments significantly increased soil OM (except 5 CD and 5 PM) when compared to the plots that had no manure. This shows that application of 5 t/ ha of cattle dung and poultry manure would be too low to give meaningful effect on soil OM and OM is the bedrock of plant nutrients. Although there was no significant increase in soil N in all the treatments compared with control, yet all the treatments still had higher N than the control experiment. Showing that

Table 4. Residual effect of poultry manure and cattle dung on soil chemical characteristics after the harvest of *Amaranthus*

Treatments	pH	OM %	N %	P mg/kg	K Cmol/kg	Ca Cmol/kg	Mg Cmol/kg
Control	5.32b	2.39c	.10a	7.16b	.13b	2.22d	1.20e
5PM	6.00b	2.39c	.11a	7.18b	.18a	2.92c	1.95b
10PM	6.60a	2.98a	.14a	10.81a	.19a	3.65c	2.30a
15PM	6.80b	2.99a	.15a	12.82a	.21a	5.47b	2.34a
20PM	7.30a	3.01a	.16a	15.00a	.25a	7.70a	2.57a
5CD	5.80b	2.29c	.10a	7.19b	.13b	2.32d	2.25b
10CD	5.71b	2.59b	.12a	7.23b	.16ab	2.35d	2.33ab
15CD	5.30b	2.58b	.12a	7.59ab	.14b	2.35d	2.32b
20CD	5.62b	2.61b	.12a	7.70b	.15b	2.49d	2.40a

Means with the same letter are not significantly different at 5% DMRT

5 t/ha of cattle and poultry manure application was low to increase soil N to the optimum level. It was observed that only poultry manure at all rates significantly increased available P, K and Ca; showing that application of poultry manure to the soil is likely to be of more benefit to the incoming crops after the harvest of amaranthus. Compared with the control, all the treatments significantly increased soil Mg showing that both poultry manure and cattle dung could be used to correct Mg deficiency.

4. CONCLUSION

An experiment was conducted to show the effect of poultry manure and cattle dung on soil chemical properties and yield of *Amaranthus cruentus* in southwestern Nigeria. Poultry manure and cattle dung increased the yield of Amaranthus and also added plant nutrients to the soil. Poultry manure performed better than cattle dung regarding plant growth and nutrient release to the soil.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Bailey JM. The leaves we eat. South Pacific Commission Handbook. 1992;33.
2. Machal MT, Phiwokwakhe D, Paul KW, Oseni TO. Effect of chicken manure on growth and yield quality of lettuce. American Eurasian Journal of Agriculture and Envir. *Sc.* 2012;12(3):399–406.
3. Okubena-Dipeolu EA. Effect of organic, organominerla and NPK fertilizers on the sensory evaluation of *Amaranthus cruentus* soup in Ikorodu and LASU. American Journal of Research communication. 2015;3(2):67–75.
4. Geier B. Organic farmers. A World of Difference. J. Sustaianable Agriculture. 1997;15:57–60.
5. Ogunlela VB, Massarirambi MT, Makuza SM. Effects of cattle manure application and pod yields and yield indices of Okra in a Semi-arid and Sub – tropical environment. J. Food Agriculture En*v*. 2005;5: 125–129.
6. Harpstead MI, The classification of some Nigerian soils. Soil Sci. 1974;116:437-447.
7. Ayeni Leye Samuel, Saliyu Mutiu, Oyegbile Sunday, Kawsar Ali. Laboratory Experiment on Soil Nutrients Mineralization and Interaction as Affected by Cocoa Pod Husk, Kola Pod Husk and Urea Fertilizer in Alfisol American Journal of Agricultural Science. 2015;2(4):144-149.
8. Makinde EA, Ayeni LS, Ojeniyi SO, Odedina JN. Effect of organic, organo-mineral and NPK fertilizers on nutritional quality of *Amaranthus* in Lagos, Nigeria. New York Journal of Science. 2010;2(2): 91-96.
9. Ayeni LS Adetunji MT, Ojeniyi SO. Comparative effect of nutrient release from cocoa pod ash, poultry manure and NPK fertilizer. Nigerian Journal of Soil Science. 2008;18:114–123.
10. Macrere AP, Gumbi GG, Nonga A. Comparative effectiveness of animal manures on amaranthus. A.O.T.S 1. 2010;4:1 -5.
11. Arisha HM, Bradisis A. Effect of mineral fertilizers and organic fertilizers on growth and yield quality of potato under sandy soil conditions. Zagazig J. Agric. Res. 1999;30: 1875.

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