Nigerian Journal of Soil Science

journal homepage:www.soilsjournalnigeria.com

COMPARATIVE EFFECT OF VARIABLE RATES OF PIG AND POULTRY MANURE ON THE AGRONOMIC PERFORMANCES OF *Amaranthus hybridus* IN HUMID RAINFOREST SOUTH WESTERN NIGERIA

[1]Sanni, K. O., [2*]Adesina, J. M., [3]Ewulo, B. S. and [3]Ojeniyi, S. O.

[1]Department of Crop Production and Horticulture, Lagos State Polytechnic, Ikorodu, Lagos, Nigeria.
[2]Department of Crop, Soil and Pest Management Technology, Rufus Giwa Polytechnic, P. M. B. 1019, Owo, Ondo State, Nigeria.
[3]Department of Crop, Soil and Pest Management, Federal University of Technology, P. M. B. 704, Akure, Ondo State, Nigeria.
** moboladesina@yahoo.com, Tel: 08037110905*

ABSTRACT

The health implication of deficiencies of vital nutrients could be supplemented by taking vegetable which are highly nutritious and easily affordable. An experiment was conducted at the Teaching and Research Farm of the Lagos State Polytechnic, Ikorodu, Nigeria, to evaluate the comparative effects of different levels of animal manure on the growth and yield of *Amaranthus hybridus*. Pig dung (PD) and poultry manure (PM) were applied at 0 t ha^{-1}, 20 t ha^{-1} and 25 t ha^{-1} respectively in Randomized Complete Block Design (RCBD) with three replicates. *A. hybridus* growth and yield parameters (number of leaves, plant height at 3 and 4 weeks after planting (WAP) and marketable yield at harvest in $Kg/5m^2$) were collected. Physical and chemical analysis of the initial soil samples were carried out. The application rate significantly ($P>0.05$) influenced the plant growth. Number of leaves, plant height and yield of *A. hybridus* increased with rate of manure application. Plot amended with 25 t ha^{-1} of PD had the highest performance in respect of number of leaves (16.4, 19.43), plant height (18.30 cm/plant, 20.63 cm/plant) at 3 and 4 WAP and marketable yield (0.73 kg/ha) at harvest respectively. Based on the findings from this study, it was recommended that soil amended with 25 t ha^{-1} PD is good for sustainable production of *A. hybridus* in Ikorodu agro-ecological zone of the humid rainforest, Southwestern Nigeria.

Keywords: assessment, influence, marketable yield, parameters, soil.

INTRODUCTION

Amaranths hybridus is an important leafy vegetable in human diet as a source of nutrients such as vitamin, minerals, sugar, water, protein and fibre needed for healthy body growth and sustenance (Bailey, 1992 and De Lannoy, 2000). High demand for

vegetables in the cities and towns has stimulated the growth of market gardening along perennial rivers and streams. Vegetable production has become a good source of employment for young school leavers. In spite of the dietary qualities, *A. hybridus* like other tropical vegetable crops has been neglected because it does not fall into the export crop category. The yield per hectare of this crop is low (7.60 t ha^{-1}) in Nigeria compared to that of United States (77.27 t ha^{-1}) and world average (14.27 t ha^{-1}) (FAO, 2007).

A. hybridus being leafy vegetable requires more nutrients than other vegetable crops hence the need for adequate fertilization. For commercial production, optimum performance of the crop must be desirable through changes in cultural practices (Sterrett and Savage, 1989). Such cultural practices include application of organic manures for improving growth and yield of crop. Some of the problems encountered by amaranth growers include decreasing soil fertility and quantity of manure required for optimum crop productivity (Lucas and Ojeifo, 1985; Adeyemi *et al.,* 1987).

The hazardous environmental consequences and high cost of inorganic fertilizers make them not only undesirable but also uneconomical and out of reach of the resource-poor farmers who still dominate the Nigeria agricultural landscape (Ogungbile and Olukosi, 1990). However, very few literatures are available on the best way of using fertilizers for vegetable crops compared with other agricultural or field crops. This is true of *A. hybridus* for which very little data on its nutrient requirements are available. Also fertilizers are applied to improve soil fertility status without particular rates.

To increase the availability of high quality amaranth throughout the year at reduced price, there is need to use organic manure such as farmyard manure which is readily available in large quantity and there is high rainfall to encourage its decomposition in Lagos State. Therefore, the objective of this study is to compare the effect of variable rates of poultry and pig manures on the growth and yield of *A. hybridus.*

MATERIALS AND METHODS

The study was conducted at the Teaching and Research Farms of Lagos State Polytechnic, Ikorodu, Nigeria (Latitude 5^0 7' and 5^0 10' and longitude 30^0 16' and 30^0 18' East of Greenwich Meridian). The mean average temperature is between 25^0C and 28.9^0C with December – February being the hottest. The annual rainfall ranges between 1000 mm – 1500 mm and relative humidity between 65 – 68% (LASPOTECH, Meteorological Station). The site was previously cultivated with maize and cassava and later allowed to fallow for two years before it was used for the trial. The dominant fallow plant species on the land was guinea grass (*Panicum maximum*), *Euphobia heterophylla*. Prior to commencement of the experiment, Surface (0 - 15 cm) soil samples was collected randomly over ten spots. Samples were bulked, air dried and ground to pass through 2 mm sieve (Carter, 1993).

Particle size distribution was determined by hydrometer method (Gee and Or 2002). Soil pH was determined using a glass electrode in 1:2 soil:water ratio (Southern Cooperative Series Bulletin 1983). Soil organic carbon (O.C) was determined using Walkley and Black method (Nelson and Sommers, 1996). Total Nitrogen was determined by Kjeldahl digestion procedure (Bremner, 1996). Available phosphorus was determined using

the Bray 1 Method and exchangeable acidity by KCl extraction method (Mclean 1965). Exchangeable Bases (Ca, Mg, Na and K) were extracted by leaching with 1N NH_40Ac (pH 7.0). Ca and Mg were determined by atomic absorption spectrophotometer and Na and K by flame emission spectrophotometer.

The plot was ploughed and harrowed to obtain fine tilth thereafter it was marked out into 18 experimental units and each measuring 1m x 5m with 1m discard between each unit. The total plot size used was $247m^2$ (13m x 19m). The amount of manure was calculated based on the manure recommendation of *A. hybridus* (Cooke, 1982 and Kogbe, 1976). The manure used was collected from the livestock section of the Teaching and Research Farms, shade dried and pulverized and later analyzed for total N, total P, total K, organic carbon, C: N ratio, Ca and Mg following standard procedures (Juo, 1979). The manures were measured as required (10.0 kg and 12.5 kg) and later worked into the soil with hoe and watered heavily for 6 days to allow for mineralization for nutrient release into the soil.

The seed of *A. hybridus* was purchased from Lagos State Agricultural Development Project, Ikorodu, 5gm of seeds were drilled per bed at 30cm rows (the seed was mixed with quantities of soil approximately twice its weight before drilling). The seedlings were later thinned at 20 cm apart to give a total of 60 stands per bed and 1,080 stands for the whole plants at 2 weeks after planting (WAP). Cultural operations such as watering and weeding were carried out as at when due. Ten (10) stands were randomly sampled and tagged per plant using balloting method. Data on the plant agronomic performance and yield, were collected: They were number of leaves, plant height at 3 and 4 WAP and marketable yield at harvest 6 WAP.

The number of leaves was counted physically, plant height was measured with a meter rule from the base of the plant to the tip while yield was determined at harvest by cutting the plant using hand sickle at 10 cm above soil surface and weighed using digital weighing balance. Data collected were subjected to analysis of variance (ANOVA) and treatment means separated using Least Significant Difference (LSD) using SAS, (1999) at 5% probability level.

RESULTS AND DISCUSSION

The physico-chemical properties of the soils at the experimental site revealed the soil were sandy loam in texture (77.20, 14.80 and 8.00 % sand, silt and clay respectively) and is acidic (pH 4.6) with low organic carbon (0.18 %), N (0.11 %), available P (0.85ppm), 2.20 cmol/kg Ca, 0.68 cmol/kg Mg, 0.14 cmol/kg K, 0.21 cmol/kg Na, 0.21 cmol/kg Mn, 0.02 cmol/kg Al respectively. Analysis indicated that poultry manure had 0.83 % N, 0.04 % Ca, 0.54 % K, 0.64 % C, 1.11 % organic matter, 11.00% Available P and 0.13% Na respectively. This implied that the experimental soil was generally low in major soil nutrients required for the good growth and yield of crop. Therefore, the soil had low fertility.

The pig manure had 1.6% Ca, 0.56% K, 0.64% Na, 0.55% C, 0.95% organic matter, 0.80% N and 14.0% available P, while poultry manure had 0.04% Ca, 0.54% K, 0.13% Na, 0.64% C, 1.11% organic matter, 0.83% N and 11.00% available P.

Table 1: Mean number of leaves, plant height at 3 and 4 WAP and marketable yield.

Treatment	No of leaves		plant height (cm)		Yield
	3WAP	4WAP	3WAP	4WAP	Kg ha^{-1}
Manure effect					
S	11.83	14.93	12.61	13.93	0.48
P	10.03	14.08	12.08	14.46	0.46
LSD(0.05)	NS	NS	NS	NS	NS
Rate effect					
0 t ha^{-1}	7.27	9.12	6.00	7.03	0.21
20 t ha^{-1}	12.63	16.30	13.98	15.23	0.49
25 t ha^{-1}	14.40	18.10	16.55	18.82	0.71
LSD(0.05)	2.90	2.09	1.26	1.55	0.18
Interaction effect					
SR_0	7.20	9.03	6.40	6.90	0.20
SR_{20}	11.90	16.33	13.13	14.27	0.53
SR_{25}	16.40	19.43	18.30	20.63	0.73
PR_0	7.33	9.20	6.60	7.17	0.22
PR_{20}	13.37	16.27	14.83	16.20	0.45
PR_{25}	12.40	16.77	14.80	17.00	0.75
LSD(0.05)	NS	1.26	1.26	1.55	NS

NB: P = Poultry manure, S = Pig dung/manure, R= Rate

The number of leaves increased with age of plant. There were no significant differences in number of leaves produced of *A. hybridus* treated with the manure at 3 and 4 WAP (Table 1). However, PD treated plots recorded highest number of leaves over PM and control plot. Significant difference in number of leaves was observed among the various manure rates. The highest number of leaves and tallest plant was recorded for manure rate of 25 ton/ha. The plots treated with 25 ton/ha had the highest number of leaves (14.40) at 3 WAP, (18.1) at 4 WAP.

These findings implied that the two sources of manure had no significant influence on the number of leaves produced. This corroborate the findings of Akparobi, (2009), that *A. hybridus* treated with the various manure levels of 0 t/ha, 15 t/ha, 25 t/ha and 35 t/ha did not show any significant difference in number of leaves at 4 WAP. However, the higher the quantity of manure applied, the higher the number of leaves produced per plant. Tindall (1975), reported that *A. hybridus* requires soils with high organic content and such soils favoured the production of leaf number and leaf area. Olufolaji *et al.* (1987), stated that the lowest fertilizer rate gave the least leaf number per plant when compared to other higher level of fertilizer application in *amaranthus*.

At 3 and 4 WAP, there was no significant difference in plant height of *A. hybridus* treated with both PD and PM (Table 1). However, PD shows promising effect over PM on plant height; significant difference was observed among the variable rates of manure evaluated. The highest plant height was recorded for plants treated with 25 tons/ha of manure at 3 (16.55 cm) and 4 (18.82 cm) WAP and control treatment reached a maximum height of 6.0 cm at 3 WAP and 7.03cm at 4 WAP. This finding agreed with the previous works of Akparobi, (2009) and Adeyemi *et al*. (1987), that adequacy or higher amount of manure applied increased the plant height of *Amaranthus.* Also, Tindall (1975), reported that *A. hybridus* requires soils with high organic content, and adequate mineral nutrients favoured the production of higher plant height in amaranthus.

Fresh weight yield obtained from the study increased with increase in quantity of manure applied (Table 1). Plants treated with 25 t/ha manure had higher fresh weight (0.71kg) than those treated with 20 (0.49 kg) and 0 t/ha (0.21kg) manure respectively and was significantly different when compared. The result indicated that for yield maximization in *A. hybridus*, manure should be applied at definite rate. Tindall (1975), reported that *Amaranthus* required soils with high organic content which favoured the production of fresh weight.

The interaction effects of variable rates of PD and PM on the parameters accessed was not significant at 0 t/ha, 20 t/ha except at 25 t/ha. The result indicated that PD performed best at 25 t/ha in all the parameters evaluated than PM which performed well at 20 t/ha and declined at 25 t/ha (Table 1). Hence, this is in agreement with the report of Kogbe (1976), who reported significant responses of *Amaranthus* to PM up to 20 t/ha.

The highest responses obtained with pig manure in this study is in line with the findings of Onweremadu *et al.* (2003) and Mbagwu *et al*. (1994) who recorded increase in soil productivity as a result of using pig manure. This could possibly be due to higher content of total N, P and K in pig manure compared to the other manure types.

REFERENCES

Adeyemi, M.O., Fakore, M.A. and Edema, A.O. (1987). Effect of poultry Manure and cutting height on the performance of *Amaranthus hybridus*. *Nigerian Journal of Agronomy,* II (1): 12–20.

Akparobi S.O. (2009). Effect of farmyard manures on the growth and yield of *Amaranthus cruentus Agricultura Tropica et Subtropica*. 41 (1): 7 – 10

Bailey, J.M. (1992) The leaves we eat. South Pacific Commission Handbook, No. 31.

Bremmer J.M. (1996). Total Nitrogen. In: Spark DL (ed) *Methods of Soil Analysis. Part 3. Chemical Methods*. No.5, ASA and SSSA, Madison, WI, pp 1085-1121

Cater, M. R. (1993). *Soil Sampling and Method of Analysis*. Canadian society of Soil Science, Lewis Publishers, 823.

Cooke, G. W. (1982). Fertility for maximum yield. Collins Professional, Pp. 94 – 95.

De lannoy, G. (2000) Vegetables. pp.403-459. In: Raemaekers. R.B (ed). *Crop Production in Tropical Africa.*

FAO (2007). Food and Agriculture Organisation. 2007 FAOSTAT. FAO Statistic Division. Rome.

Gee GW, Or D (2002). Particle Size Analysis In: Dane J.H, Topp GC (eds) Soil Sci Soc Am Book Series No. 5. ASA and SSSA, Madison, WI. pp 255-293.

Juo, A. S. R. (1979). Soil and Plant Analysis. International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. Tech. Bull. (12), 132.

Kogbe, S. O. (1976). Studies of manorial Requirements of Nigerian leafy vegetables: effect of poultry manure on component yield of bush okra. *Nigerian Journal of Agriculture* 19(20):145-152.

Lucas, E.O. and Ojeifo, I.M. (1985). Partitioning of dry matter and nutrient in two varieties of amaranths. *African Journal of Agricultural Science,* 12 (1 & 2): 39–48.

Mbagwu, J. S. C., Unamba-Oparah, I. and Nevoh, G. O. (1994). Physical-chemical properties and productivity of two tropical soils amended with dehydrated swine waste. *Boil. Wastes*, (49), 163-171.

Mclean EO (1965) Aluminium. In: C.A Black (ed) *Method of Soil Analysis* Parts, Agron. 9. American society of Agronomy, Madison, Wiscosin. pp 986 – 994

Nelson, D. W. and Sommers, (1996). Total carbon, organic carbon and organic matter. In: Page A. L., R. H. Miller and D. R. Keeney (Eds.) *Methods of Soil Analysis*, Part 3. Second ed. SSSA Book Series No. 5, SSSA, Madison, WI, USA, 961 – 1010.

Ogungbile, A.O. and Olukosi, J. (1990). An overview of the problems of the resource-poor farmers in Nigeria. *Proceedings of the Nigerian National Farming Systems Research Network*, Calabar, 14- August, 1990

Olufolaji, A. O., Tayo, T. O., Kayode, P. A., Adeyemi, M. (1987). Analysis of leaf appearance, expansion, and duration in amaranthus. *Annual Report*, National Horticultural Research Institute, Ibadan.

Onweremadu, E. U., Oti, N. N., Ibeawuchi, I. I. and Obilo, O. P. (2003). Effect of Dehydrated Pig Manure (DPM) on maize yield on a degraded soil of Owerri, Southeastern Nigeria. *Proceedings of the 28th Annual Conference of Soil Science Society of Nigeria (SSSN)*, Umudike, pp. 81–86.

SAS Institute, Inc. (1999). *SAS user's guide*. Statistics Version 8, SAS Institute Inc. Raleigh, N.C., U.S.A.

Southern Cooperative Series Bulletin (1983). Reference soil test methods for the Southern Region of the United States. The University of Georgia, College of Agriculture Experimental Station. Southern Cooperative Series Bulletin No. 289.

Sterrett, S. B. and G. P. Savange (1989). Culinary herbs as alternative crops. *The vegetable Growers News*. 42(1):3-4.

Tindall, H. D. (1975). *Commercial vegetable growing: Oxford Tropical Handbook*. Oxford University Press.