EFFECT OF ORGANIC, ORGANOMINERAL AND NPK FERTILIZER ON NUTRITIONAL QUALITY OF AMARANTHUS IN LAGOS, NIGERIA

[1]Makinde, E.A. [2*]Ayeni, L. S and., [3]Ojeniyi, S.O[1] [4]Odedina J.N.

[1]Department of Botany, Lagos State University, Ojo, Lagos, Nigeria.
[2]University of Agriculture, Department of Soil Science and Land Management, Abeokuta, Ogun State, Nigeria
[2]Department of Crop Soil and Pest Management, Federal University of Technology, PMB 704, Akure, Nigeria.
[4]University of Agriculture, College of Plant Science, Abeokuta, Ogun State, Nigeria
[2*] Author for correspondence. leye_sam@yahoo.com

ABSTRACT

In Nigeria, organic fertilizers are being developed from organic and farm wastes and these can be fortified with inorganic. Therefore eight fertilizer treatments namely: (1) control (no fertilizer), (2) Pacesetter Grade B organic fertilizer (PGB) at 3t/ha 100%, (3) 300 kg/ha NPK fertilizer, (4) PGB + NPK fertilizer (75:25), (5) PGB + NPK (50:50), (6) Kola pod husk (KPH) at 3t/ha 100%, (7) KPH + NPK (75:25), and (8) KPH + NPK (50:50), were applied to amaranthus (Amaranthus cruentus). Residual effect on second and third crops was also studied. Proximate analysis was done to determine crude protein (CP), crude fibre (CF), ash and ether extract (EE). The PGB and KPH alone or combined with reduced level of NPK generally increased CP, ash and EE significantly on immediate and residual basis. The organic fertilizers had more residual effect than NPK. Organic materials alone or combined with NPK reduced CF especially on residual basis. Compared with organic materials, NPK gave least values of CP, ash, CF and EE. Application of KPH + NPK (50:50), KPH and PGB gave highest values of CP and ash respectively. Integrated application of organic fertilizers and NPK gave highest values of EE in order PGB + NPK (50:50), KPH + NPK (50:50), and PGB + NPK (75:25). Organic fertilizers and OMF maintain adequate CP and EE in first and second crops whereas NPK did not maintain adequate CP in second crop. [Researcher. 2010;2(2):91-96]. (ISSN: 1553-9865).

Key Words. Ash, crude protein, fibre, residual effect, integration

INTRODUCTION

Most vegetable farmers in tropical countries such as India, Malaysia, Indonesia, Philippines, South Pacific and tropical Africa are small holders who cannot afford cost of inorganic fertilizers, although soil fertility limits yield of vegetables especially in urban and periurban centres. Hence farmers depend largely on locally sourced organic fertilizers. In Nigeria organic fertilizers are being developed from farm and city wastes, also organomineral fertilizers (OMF) in which organic wastes are fortified with inorganic N or NP fertilizers. Since different organic wastes influence nutritional quality of crops differently, evaluating performance of different brands and composition of organic and organomineral fertilizer in relation to conventional mineral fertilizer is imperative.

Organic and organomineral fertilizers were found to increase significantly yield of maize and vegetables such as pepper, tomato, okra, melon and amaranthus (Ipinmoroti, 2003, Fagbola and Dare, 2003, Olowokere 2004, Adeoye et al, 2008, Ojeniyi and Adejobi, 2002, Ojeniyi et al, 2009, Akanni and Ojeniyi 2008, Makinde 2007. However there is scarce research information on effect of organic and organomineral fertilizers on nutritional quality of amaranthus. Adekayode (2004) found that wood ash, goat and poultry manures increased fat, protein and reduced carbohydrate in amaranthus.

The objective of this work is to study effect of kola pod husk (KPH), a farm waste, and pacesetter grade B organic fertilizer (PGB) used alone or in combination with NPK fertilizer on crude protein, crude fibre, ether extract and ash in amaranthus.

MATERIALS AND METHODS

Experiment was conducted at Ikorodu farm settlement (6^0 37'N, 30^0 53'E) and Lagos State University (LASU) Ojo (6^0 27'N, 30^0 13'E) in rainforest and swamp forest areas respectively. The soils at Ikorodu and LASU were classified as Orthic luvisol and dystric fluvisol respectively. The soils are sandy, high leached and deficient in N,P,K, Ca and Mg. (Makinde, 2007), expecially at LASU.

Organic manures used were kola pod husk (KPH) and pacesetter Grade B(PGB) composed from non-fortified sorted city refuse, poultry waste, cowdung, sawdust and water hyacinth. The KPH was obtained form kola processing unit of Cocoa Research Institute of Nigeria and PGB obtained from pacesetter organic mineral fertilizer plant Bodija Ibadan. The KPH was oven dried at 70^0C to constant weight and made to pass through 2mm sieve. The test crop was Amaranthus cruentus variety (ED82/1019) early maturing type. The optimum N requirement (67.5 kg N/ha) for amaranthus was used to amend organic manures at ratios3:1 and 1:1 organic: NPK fertilizer respectively. Eight treatments used were (i) control (no fertilizer), (ii) KPH at 3t/ha(100%), (iii)KPH + NPK (75:25), (iv) KPH + NPK (50:50), (v) PGB at 3t/ha (100%), (vi) PGB + NPK (75:25),(vii) PGB + NPK (50:50), and (viii) NPK (100%).

Experiment was laid out in a ramdomized complete block design with four replicates per location. Land area was 27 x16m per location. Manure and fertilizer were incorporated in seedbeds. Seedlings were raised and transplanted at 10cm x 20cm using one seedling per hole. Harvesting was done 6 weeks after transplanting. Leaf samples were oven dried at 60^0C to constant weight. Dried samples were ground and passed through 2mm sieve. The ash, crude fibre and ether extract were determined as described by AOAC(1990). Nitrogen was obtained by microkjedahl method and percent N converted to protein by multiplying with 6.25.

The experiment was repeated without any fertilizer application at second and third planting periods to study residual effect of treatments.

Analysis of variance was performed on the data and means separated using Duncan's multiple range test.

RESULT AND DISCUSSION

Data on nutrient composition of PGB and KPH are in Table1. The organic materials have considerable contents of N, P, K and Ca which on decomposition of the materials would be released for crop uptake and synthesis of protein, crude fibre, ash and ether extract as appropriate. The KPH clearly had more N, P, K and Ca than PGB.

Data of proximate analysis of first, second and third crops of amaranthus are shown in Tastes 2, 3 and 4 respectively.

Crude Protein:

PGB and KPH alone or combined at reduced levels with NPK increased crude protein significantly on immediate basis, and on residual basis in case of second and third amaranthus at Ikorodu and LASU locations.

NPK fertilizer also increased CP on immediate basis at Ikorodu, and on residual basis in case of second crop at both locations. However NPK had no residual effect or had insignificant effect in case of third crop, as opposed to PGB and KPH alone or fortified with NPK. Therefore organic fertilizers had more residual effect on CP than NPK.

Crude Fibre:

Organic and NPK fertilizers tended to reduce CF in amaranthus at Ikorodu and LASU. However at LASU KPH alone or combined with NPK at 75:25 reduced CF relative to control. At Ikorodu, KPH combined with NPK at 50:50, PGB combined with NPK at 75:25 and NPK reduced CF. In case of second crop, applications of organic fertilizers alone or combined with NPK reduced CF. Exceptions were found in NPK or KPH combined with NPK at 50:50, and NPK at LASU. With regard to third crop, organic materials used alone or combined with NPK generally reduced CF. Therefore the materials had residual effect up to the third crop.

Ether Extract (EE)

At Ikorodu, PGB or KPH alone and in combination with NPK increased EE in amaranthus relative to control, similar observation applies at LASU except in case of PGB, KPH, NPK + KPH (50:50). However in the second crop, PGB or KPH alone or combined with NPK increased EE relative to control (except NPK at Ikorodu). In the third crop, organic materials alone or combined with NPK, and NPK alone increased EE significantly.

Ash

Generally the organic materials alone or combined with NPK increased ash significantly in first and second amaranthus. Similar observation was made at LASU in case of third crop. Therefore there was residual effect of fertilizers.

Mean data covering the two locations and three test crops are shown in table 5. It is shown that relative to control, PGB, KPH alone or combined with reduced levels of NPK and NPK alone increased ash, CP and EE in amaranthus, while CF was reduced. Thus the organic materials alone or integrated with NPK increased nutritive quality of amaranthus.

The NPK gave least values of CP, CF, ash and EE compared with organic materials alone or combined with NPK. This could be due to the ease with which nutrients such as N, P and K in NPK fertilizer was lost by leaching. Nutrients in organic materials are less easily available since the materials have to be decomposed and organic nutrients mineralized. Nutrients released from NPK and organic sources such and N, P and K are formation blocks for protein (N), nucleoprotein (P), ash (K) and ether extract (P in form phospholipids) (Brady 1974). Through its effect in chlorophyll formation, photosynthesis and leaf formation, N influences starch formation and crude fibre. Alabi and Odubena (2008) indicated that leaf chlorophyll of organic fertilizer treated crops was higher than NPK treatment crops. This explains least values for NPK treated amaranthus in the present study.

Comparison of PGB and KPH indicated that the latter produced higher nutritive quality of amaranthus (Table 5). It gave higher mean values of CP, ash and EE. KPH also gave higher values of CP and ash in four out of six instances. Greater influence of KPH on crop quality could be due to higher concentrations of nutrients (N, P, K, C a) recorded for it (table 1). On sustainable basis, organic and organomineral treatments did not maintain good quality of amaranthus in relation to Cp as reflected in the third crop. Treatment KPH + NPK (75:25), and KPH + NPK (50:50) maintained high quality of amaranthus in the first and second crops because the CP content was above the critical 13-17% (Oyenuga and Fetuga, 1975; Rubatizky and Yamaguchi; 1997). Also PGB + NPK (50:50) gave CP above the cirtical in the second crop, and also KPH. NPK did not maintain adequate CP in second and third crops. Therefore the organic materials used alone or combined with NPK at reduced levels sustained good nutritive quality of amaranthus as opposed to NPK fertilizer. All treatments maintained high free extract, the values being higher than critical 0.3% (Oyenuga and Fetuga, 1975). However it is the protein that is most limiting in human nutrition in the tropics. Organic and organ mineral fertilizer should be applied to amaranthus after the second crop to maintain adequate protein content.

Table 1. Analysis of pacesetter organic fertilizer (PGB) and kola pod husk (KPH).

Element	PGB	KPH
N%	0.94	1.06
P%	0.28%	6.0
K%	1.15%	4.97
Ca%	1.19%	1.61
Nag%	Nd	0.28

Source for PGB: Pacesetter Fertilizer Company Ibadan, Nigeria.
Source for KPH: Cocoa Research Institute of Nigeria, Ibadan.
Nd = not determined.

Table 2 Effects of fertilizers on proximate analysis of amaranthus at Ikorodu and LASU

Treatment	IKORODU				LASU			
	Crude Protein	Crude Fibre	Ether Extract	Ash %	Crude Protein	Crude Fibre	Ether Extract	Ash %
control	10.63f	13.90e	2.59g	11.95h	12.75g	10.30b	5.09e	15.15e
PGB (100%)	13.13C	14.30c	2.27h	15.91f	15.75f	10.87a	5.15d	18.88d
PGB+ NPK (75:25)	12.56d	12.15g	5.52b	15.79e	15.88d	10.93a	2.82h	19.14c
PGB+ NPK (50:50)	14.13d	15.32g	5.08d	14.41f	15.81e	10.93a	3.04g	18.94d
KPH (100%	12.13b	15.71a	3.09f	17.53a	17.56b	8.42d	5.42b	22.54b
KPH+NPK (75:25	13.19c	14.09d	4.53e	16.62b	17.69a	9.83c	3.82f	23.18a
KPH + NPK (50:50)	13.56b	12.99f	5.69a	16.06c	17.38c	10.83a	9.51a	19.21c
NPK (100%)	18.81a	11.58h	5.10c	11.9g	12.63g	10.49b	5.21c	14.62f

PGB = Pacesetter Grace B: KPH = Kola Pod Husk. NPK = NPK 15:15:15 Fertilizer
Means having the same letters(s) in the same column are not significantly different at 5% Duncan Multiple Range Test (DMRT)

Table 3: Residual effects of fertilizers on Proximate analysis of second crop of amaranthus at Ikorodu and LASU

Treatment	IKORODU				LASU			
	Crude Protein	**Crude Fibre**	**Ether Extract**	**Ash %**	**Crude Protein**	**Crude Fibre**	**Ether Extract**	**Ash %**
Control	7.00h	12.70b	2.48g	14.09f	1.25h	13.15c	1.89h	14.91f
PGB (100%)	9.38f	12.63c	2.88e	13.95g	14.68b	10.83h	7.65b	17.37c
PGB+ NPK (75:25)	10.00e	9.48h	6.63b	14.89e	14.88a	10.96g	8.23c	15.85e
PGB+ NPK (50:50)	13.13d	10.56g	8.48a	15.96b	14.44c	11.57e	7.08c	11.52h
KPH (100%	13.35c	12.52d	3.46f	16.71a	6.25d	11.25f	3.29f	19.65b
KPH+NPK (75:25	19.50b	12.15e	5.34c	15.05c	3.31e	12.92d	3.37e	16.74a
KPH + NPK (50:50)	19.75a	13.38a	5.26c	14.91d	2.88f	13.79d	3.95d	16.40d
NPK (100%)	7.25g	11.17f	2.16d	12.63h	2.19g	14.94a	2.10g	13.84g

PGB = Pacesetter Grace B: KPH = Kola Pod Husk. NPK = NPK 15:15:15 Fertilizer
Means having the same letters(s) in the same column are not significantly different at 5%.

Table 4: Residual effects of fertilizers on Proximate analysis of third crop of amaranthus at Ikorodu and LASU

Treatment	IKORODU				LASU			
	Crude Protein	Crude Fibre	Ether Extract	Ash %	Crude Protein	Crude Fibre	Ether Extract	Ash %
Control	2.81g	10.71b	2.24f	28.53c	1.44f	15.50a	2.12h	11.18h
PGB (100%)	5.38e	7.70h	3.14f	31.80b	1.88d	12.16d	7.83e	20.50d
PGB+ NPK (75:25)	4.88f	8.58e	5.55c	22.77f	1.88d	11.60e	7.77f	17.64f
PGB+ NPK (50:50)	5.50d	11.80a	5.46d	23.38e	1.94c	12.46c	9.85b	20.09f
KPH (100%	10.25a	9.98d	5.69a	20.38g	2.06b	7.23h	9.93a	22.38b
KPH+NPK (75:25	7.31c	8.50f	4.54e	17.57h	1.88d	12.63b	7.86c	17.02g
KPH + NPK (50:50)	9.88b	8.45g	5.61b	32.12a	2.50a	9.49f	7.83d	20.52c
NPK (100%)	1.4h	10.05c	2.55g	23.78d	1.49e	7.46g	11.14d	23.41a

PGB = Pacesetter Grace B: KPH = Kola Pod Husk. NPK = NPK 15:15:15 Fertilizer
Means having the same letters(s) in the same column are not significantly different at 5%.

Table 5. Mean data of proximate analysis for three crops and two locations (%).

Treatment	Crude protein	Crude fibre	Ash	Ether extract
Control	6.0	12.7	10.9	2.74
PGB	10.0	12.1	19.7	4.82
PGB + NPK (75:25)	10.0	10.6	17.7	6.08
PGB + NPK (50:50)	10.8	12.1	17.4	6.50
KPH	10.3	10.8	19.9	5.14
KPH + NPK (75:25)	9.9	11.6	17.7	4.91
KPH + NPK (50:50)	11.0	11.5	19.9	6.30
NPK	7.3	10.8	16.7	4.70

CONCLUSION

Kola pod husk and pacesetter organic fertilizer at 3t/ha alone or combined with NPK fertilizer at reduced levels are suitable for improving nutritional quality of amaranthus. The organic materials had residual effect on protein, either extract and ash content in first and second crops. They are recommended for use in cultivation of amaranthus

.

REFERENCES

1 Ipinmoroti, R.R., G.O. Adeoye and M.A. Daniel. 2003. The comparison of locallyblended organic fertilizers on Amaranthus cruentus L. production at Ibadan southwestern Nigeria. Proceeding Horticultural Society of Nigeria 21st Conference, Ikorodu. p 58-65.

2 Fagbola, 0. and Dare, M.O.2003. Performance of pepper on simulated degraded and non-degraded soil as affected by mycorrhiza inoculation and organomineral fertilizer. *Nigeria Journal of Horticultural Science* 8, 11-14.

3 Olowokere, F.A. 2004. Response of pepper and tomato intercrop to different rates and methods of application of poultry based organomineral fertilizer. Proceeding 29th Annual Conference of Soil Science Society of Nigeria, UNAAB. p 186-191

4 Adeoye G.O., O.O. Ade Oluwa, M. Oyekunle, M.K.C. shridhar, E.A. Makinde and Olowoake, A.A. 2008. Comparative evaluation of oragnomineral fertilizer (OMF) and mineral fertilizer (NPK) on yield and quantity of maize, *Nigerian Journal of Soil Science* 18, 132-137.

8 Adekayode, F.O. 2004. The use of manure to increase the yield of and quality of amaranthus to feed rabbit in a humid tropical region. *Journal of Animal and Veterinary Advances* 3, 758-762.

5 Ojeniyi, S.O. and K.B. Adejobi,2002. Effect of ash and goat dung manure on leaf nutrients composition growth and yield of amaranthus. *Nigeria Agriculture Journal* 33, 46-57.

6 Ojeniyi, S.O., Owolabi, O., Akinola, O.M. and Odedina, S.A. 2009. Field study of effect of organomineral fertilizer on maize growth yield soil and plant nutrient compositon in Ilesa, southwest Nigeria. *Nigeria Journal of Soil Science* 19, 11-16.

. 7 Makinde, E.A. 2007. Evaluation of organomineral fertilizer on growth and yield and quality of Amaranthus cruentus on two soil types in Lagos State, Nigeria. Ph.D. Thesis Department of Agronomy, University of Ibadan. Pp 154.

8 Akanni, D.I. and Ojeniyi, S.O. 2008. Residual effect of goat and poultry manures on soil properties and yield of amaranthus in southwest Nigeria. *Research Journal of Agronomy* 2, 44-47.

9 Alabi, D.A. and Y. Odubena, 2001. Apreliminary study of the effect of two organic wastes and NPK (15:15:15) on the growth and yield of cowpea. *Nigeria Journal of Horticultural Science* 8, 19-27.

10 AOAC (1990). Official Methods of Analysis. Association of official Analytical chemists, 15th Edition, Washington, D,C.

11 Brady, N.C. 1974. The nature and properties of soil. Macmillan Publishers, New York pp422.

12 Oyenuga, V.A. and B.I. Fetuga, 1975. Dietary importance of fruits and vegetables. Proceeding First National Seminar on Fruits and Vegetables. University of Ibadan . October 13-17. p 122-131.

13 Rubatizky, V.E. and M. Yamaguchi. 1997. World Vegetables: principles, production and nutritive values, 2nd edition International Thomas Publishing. New York. Chapman and Hall.

Date of submission 10/2/2010