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Research Paper

Comparative Study on the Nutritional Composition of African Spinach (*Amaranthus Cruentus*) Produced Using Organic and Inorganic Fertilizer

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ABSTRACT
This research was conducted in Biu Dam, Borno State to investigate the influence of organic and inorganic fertilizers on the nutritional composition (Phytochemicals, proximate, minerals, antioxidants and vitamins A and C) of African Spinach. Randomized block design replicated three times was used. Seeds were obtained from local vegetable farmers in Dadin-Kowa, Gombe State and recommended cultural practices carried out. Poultry droppings and cow dungs: 500 kg/ha and inorganic fertilizer (NPK 15:15:15, 500 kg/ha) were applied to the soil at two weeks and five weeks after emergence (WAE). Twenty matured plants were randomly uprooted / plot at 9 WAE. Leaves, stems, roots and inflorescences were separated, oven dried at 70°C and Chopped stems, roots at 74°C for 24hrs. The powder was weighed and the data recorded was analysed using SPSS package. Means were separated by student t-test expressed as percentage difference at 5% probability. Result has shown that organic fertilizer produced significantly higher nutritional properties in leaf at P < 0.05; (crude protein 8.01±0.01 g/100g, fiber 3.80±.02g/100g, fat 0.50±0.2g/100g, moisture 92.40±0.2 g/100g, vitamin C 47.01±0.01µg/100g and A 9.00±0.02 µg/100g). Leaf part showed that protein, carbohydrate, fat, moisture and vitamin C with mean values of 4.20±.02, 89.54±0.02, 0.34±0.02, 76.60±0.01 g/100g and 10.10±0.03 µg/100g respectively for plants treated with organic fertilizer are significantly different from plant treated with inorganic fertilizer, with mean values of 3.60±.01, 85.40±0.02, 0.29±0.01, 75.10±0.01 g/100g and 8.43±0.02 µg/100g respectively. Mean values for ash, fibre and Vitamin C were higher in the inflorescence of organic grown plants. This work concluded that organic grown spinach had highest protein composition which provides a source of vegetable protein. Although both inorganic fertilizer (NPK) and organic (PM) increased soil fertility, but inorganic grown plants performed better in terms of growth and differ in nutritional quality. Thus, the use of FYM manure in vegetable cultivation is cheaper, more available and nutritionally better. The researchers recommended that people should eat vegetables not just for likeness but also for the nutritional benefits. Organic cultivated vegetables should be preferred for the unique nutritional quality, and because it is cheap, abundant, eco-friendly and sustainable in soil, farming communities should gather organic- waste for fertilizer and thus boost their socio-economic status.

KEYWORDS: *Organic and Inorganic Fertilizer, Nutritional composition, African Spinach, Farm Yard Manure (FYM).*
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I. INTRODUCTION

The African Spinach (*Amaranthus Cruentus*) is a leafy vegetable crop popularly called ‘‘Alaihu’’ in Hausa language commonly consumed in Northern Nigeria as it supplies fiber, minerals and vitamins to the diet of people in the developing countries, where they are consumed as side dish or relish with staple foods (Ojeniyi *et al*., 2009). Spinach contains protective food for the maintenance of health and prevention of diseases. In Africa, especially Nigeria green leafy vegetables are consumed as soup complements of major staples like cassava, cocoyam, guinea corn, yam, maize, millet, rice and unripe plantain. Vegetables contribute to food security and add spice and variety to the starchy staples either as soup or porridge. In Nigeria, especially among the rural population, there is limited information on the nutrient profile of staple vegetables, which are abundant during both rainy season (consumed in large amount), but are scarce in the dry season (Ukom and Obi, 2018).

FAO has defined organic agriculture as a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. Organic and inorganic fertilizers are essential for plant growth, both supply plants with nutrients needed for optimum performance. Organic fertilizers have been used for many centuries whereas inorganic fertilizers were only developed during the industrial revolution. The hazardous environmental consequences and high cost of inorganic fertilizers made them not only undesirable but also uneconomical and out of reach of the poor farmers who still dominate the Nigerian Agricultural sector (Shiyam and Binan, 2011). This has led to increased use of organic manure, a readily available alternative, which is environmentally friendly.

In recent times however, attention has been directed towards organic manure because of the rising cost of inorganic fertilizers coupled with their inability to give the soil the desired healthy nutrients. Poultry manure is an excellent soil amendment that provides nutrients for growing crops and also improves soil quality when applied appropriately, due to its high organic matter content combined with available nutrients for plant growth (VanRyssen *et al.,* 1993).

Purpose of this Study

Several studies have centered on the effect of organic, inorganic fertilizer or used in combination on soil properties, nutrients uptake, growth, yield and some minerals contents. However, there is scarce information on the effect of organic and inorganic fertilizer on nutritional composition (Phytochemicals, proximate, minerals, antioxidants and vitamins A and C) in African Spinach.

The objective of the study

The objectives of this study are to compare the nutritional content of African Spinach cultivated using organic and inorganic fertilizers and to determine the most cost-effective fertilizer for cultivating the *A. cruentus on* both commercial and subsistence level.

II. METHODOLOGY

This research was conducted in irrigation demonstration plot of Biu Dam, Borno State. The experiment was laid out in a randomized block design replicated three times. The land was cleared and seedbeds prepared using hoe. Seeds of *Amaranthus cruentus* were obtained from a local vegetable farmers in Dadin-Kowa, Gombe State, 3 to 5 seeds sown at a depth of 3mm which was thinned to 3 per stand at 10 cm by 20 cm spacing, (Mofunanya*et al*., 2014). Poultry droppings and cow dungs: 500 kg/ha and inorganic fertilizer (NPK 15:15:15, 500 kg/ha) were applied to the soil at two weeks and five weeks after emergence (WAE). *A. cruentus* was harvested three months WAE.

At the end of the experiment, 20 matured plants were randomly uprooted from each plot (Mofunanya *et al*., 2014). Leaves, stem, root and inflorescence were separated using knife. Leaf and inflorescence were then dried at 70°C for 24 hours. Stems and roots were cut to smaller pieces and oven-dried at 74°C for 24 hours to a constant weight and milled into powder in an electric blender. 100 g of each of the plant part was weighted using an automated electric weighing machine and the data were recorded.

Determination of the Proximate Composition

The proximate composition (Crude protein, ash, fibre, carbohydrate and moisture) were determined by the standard method of the Association of Official Analytical Chemists (A. O. A. C. 1995). Vitamin A was determined spectrophotometrically using the hexane method and vitamin C by modified method of Bessey (1944).

Data Analysis

The SPSS package was used to analyze the data. Student t-test was used to compare the nutritional contents of *A. cruentus* produced with organic and inorganic fertilizer. Results were also expressed as percentage difference and differences between mean values were determined at 5% probability.

III. RESULTS AND DISCUSSIONS

Result has shown that organic fertilizer produced significantly higher nutritional properties in leaf at $P < 0.05$, crude protein 8.01±0.01 g/100g, fiber 3.80±.02g/100g, fat 0.50±0.2g/100g, moisture 92.40±0.2 g/100g, vitamin C 47.01±0.01µg/100gand A 9.00±0.02 µg/100g (Table 1). Similar nutritional properties are also found in stem part of the vegetable. This result corresponds with the findings of Mofunanya*et al*., (2014) who reported higher nutrition in *Amaranthus spinosus* when organic fertilizer was applied to seedlings of the vegetable after 2 weeks of transplanting. These increased nutritional properties of *A. cruentus* were due to the application of poultry manure. There was no significant difference in the carbohydrate and ash content of the leaf.

Table 1: Nutritional analysis of leaf and stem of *Amaranthus cruentus* produced using organic and inorganic fertilizer

Treatment	Plant Part	Protein	Carbohydrate	Fibre	Ash	Fat	Moisture	Vitamin. A	Vitamin. C
Organic	Leaf	8.01±0.01	89.27± 0.02	3.80 ± 0.2	2.30 ± 0.2	0.50 ± 0.2	92.40 ± 0.2	47.01± 0.01	9.00 ± 0.02
Inorganic		6.80±0.01	89.06± 0.01	2.60±0.02	2.50 ± 0.1	0.43 ± 0.1	87.52 ± 0.2	42.40 ± 0.1	6.50 ± 0.02
Control		4.20±0.01	88.84± 0.02	1.70±0.01	2.40 ± 0.01	0.39 ± 0.01	85.40± 0.02	40.05± 0.02	4.55 ± 0.01
Organic	Stem	3.40 ± 0.1	90.82± 0.01	3.10±0.01	3.20 ± 0.1	0.30 ± 0.1	79.43 ± 0.1	45.17± 0.02	7.78 ± 0.2
Inorganic		2.80 ± 0.1	90.82 ±0.01	2.90 ± 0.2	2.81 ± 0.1	0.24 ± 0.01	78.50± 0.02	45.17± 0.02	7.78 ± 0.2
Control		2.20 ± 0.2	90.39± 0.01	2.80±0.01	2.50 ± 0.01	0.20 ± 0.2	78.40± 0.01	40.30 ± 0.2	5.05 ± 0.1

Mean vales ± SD, P<0.05.

Table 2 showed the nutritional composition of root and inflorescence part of the A. cruentus when organic and inorganic fertilizer was applied. Result of leaf part showed that protein, carbohydrate, fat, moisture and vitamin C with mean values of 4.20±.02, 89.54±0.02, 0.34±0.02, 76.60±0.01 g/100g and 10.10±0.03 µg/100grespectively for plants treated with organic fertilizer are significantly different from plant treated with inorganic fertilizer, with mean values of 3.60±.01, 85.40±0.02, 0.29±0.01, 75.10±0.01 g/100g and 8.43±0.02 µg/100g respectively. Mean values for ash, fibre and Vitamin C were higher in the inflorescence of plants treated with organic fertilizer. This discovery is not different from the findings of Katherine (2007) who reported that organic grown food is more nutritious than non-organic grown food which gives quality food and may lengthen people's life. However results differ from the findings of Oyedeji *et al.*, (2014) who reported that Amaranthus species grown with NPK significantly had higher protein, while those grown with poultry manure had higher ash content.

Table 2: Nutritional analysis of root and inflorescence of*Amaranthus cruentus* produced using organic and inorganic fertilizer

Soil Type	Plant Part	Protein	Carbohydrate	Fibre	Ash	Fat	Moisture	Vit. A	Vit. C
Organic	Root	4.20 ± 0.02	89.54± 0.02	4.50 ± 0.02	3.30 ± 0.2	0.34 ± 0.2	76.60± 0.01	30.11± 0.02	10.10 ± 0.03
Inorganic		3.60± 0.01	85.40± 0.02	4.20 ± 0.01	2.74 ± 0.1	0.29 ± 0.1	75.10 ± 0.2	29.87± 0.02	8.43 ± 0.2
Control		3.20 ± 0.1	83.50± 0.01	4.0 ± 0.1	2.20 ± 0.01	0.25 ± 0.01	73.40± 0.02	28.50 ± 0.2	6.50 ± 0.2
Organic	Infloresc	1.90 ± 0.02	81.50± 0.02	2.70 ± 0.1	3.40 ± 0.01	0.15 ± 0.2	75.80± 0.02	46.05 ± 0.2	11.08 ± 0.1
Inorganic		1.70 ± 0.02	81.10± 0.01	2.30 ± 0.2	3.30 ± 0.1	0.13 ± 0.2	73.30± 0.02	41.90 ± 0.2	8.45 ± 0.01
Control		1.30 ± 0.02	80.71± 0.02	2.0 ± 0.2	3.0 ± 0.01	0.10 ± 0.2	71.40± 0.02	33.50 ± 0.2	7.15 ± 0.02

Mean vales ± SD, P<0.05.

IV. CONCLUSION

This work concluded that organic grown spinach had highest protein composition which provides a source of vegetable protein. Although both inorganic fertilizer (NPK) and organic (PM) increase soil fertility, but plants grown with inorganic fertilizer performed better in terms of growth and only differ in nutritional quality. Thus, the use of FYM manure in vegetable cultivation is cheaper, more available and nutritionally better.

V. RECOMMENDATIONS

This research encourages the people to eat vegetables not just for likeness but also for the nutritional benefits derived from them. Higher amounts of protein, moisture, ash, fiber and vitamins are recorded when cultivated using organic fertilizer. Organic fertilizer should be preferred in cultivating *A. cruentus* for better nutritional quality, cheap, abundant, eco-friendly and more sustainable in soil. Farming communities should take interest in agricultural waste gathering as sources of fertilizer and increase their socio-economic status. Government and non-governmental organisations should educate vegetable farmers on through the extension agents, media on the need to use the alternative source of plant nutrients.

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