



## Effect of Different Fertilizer Rates on the Phytochemical and Proximate Composition of *Amaranthus* Species in Lapai, Niger State

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### ABSTRACT

In comparison to cereals, Amaranths features high nutritional value. Field study was conducted at the Ibrahim Badamasi Babangida University, Lapai, Niger State during the 2017 rainy season to evaluate the effect of organic and inorganic fertilizer on the phytochemical and proximate composition of *Amaranthus* species. Two varieties of *Amaranthus* (*Amaranthus hybridus* L. and *Amaranthus cruentus* L.) and five rates of fertilizer (NPK 15:15:15 at 0, 20, 40 Kg/ha and poultry manure at 2 t/ha and 4 t/ha) was used. The experiment was laid out in a Randomized Complete Block Design replicated three times. The stems and leaves of *Amaranthus* spp were collected and air dried in the laboratory for two weeks and crushed with sterilized mortar and pestle, the fine samples was used for Phytochemical and proximate analysis in the laboratory. Results indicated that Phytochemical composition of *Amaranthus* showed higher tannins and saponins in *Amaranthus hybridus* and saponins in *Amaranthus cruentus* with a mean value of  $0.55 \pm 0.01$ ,  $0.95 \pm 0.03$  and  $1.80 \pm 0.10$  at 40 and 20 Kg/ha NPK respectfully. Alkaloids ( $4.96 \pm 0.01$ ) was greater in *Amaranthus hybridus* at 2 t/ha of poultry manure. The proximate composition of *Amaranthus* revealed higher Ash content ( $10.80 \pm 0.10$ ) and crude protein ( $22.70 \pm 0.10$ ) in *Amaranthus hybridus* at 2 t/ha poultry manure, while fat ( $3.50 \pm 0.10$ ) and crude fibre ( $11.27 \pm 0.25$ ) were favoured at 20 kg/ha and moisture content ( $85.65 \pm 0.52$ ) of *Amaranthus cruentus* at 4 t/ha was greater. Generally, NPK fertilizer influenced more of the phytochemicals, while poultry manure influenced more of the proximate composition of *Amaranthus* in this study.

**Keywords:** *Amaranthus*, phytochemical, proximate, poultry manure, inorganic

### INTRODUCTION

Amaranth originated in America and is one of the oldest food crops in the world, with evidence of its cultivation reaching back as far as 6700 BC. (Jansen van Rensburg, 2007). *Amaranthus* L. is a genus in the family *Amaranthaceae* consisting of more than 60 species, including cultivated grain amaranth species (e.g., *A. caudatus*, *A. cruentus*, and *A. hypochondriacus*) and leaf vegetable types (e.g., *A. hybridus* and *A. tricolor*) (Akin-Idowu *et al.*, 2016).

According to Akin-Idowu *et al.* (2016), *Amaranthus* spp are grown in the temperate and tropical climates, and are used as grain or vegetable. At present, amaranth is extensively grown as a green, leafy vegetable in many temperate and tropical regions. Meanwhile,

amaranth had spread around the world and had become established for food use (the grain or leaves) in places such as Africa, India and Nepal (Jansen van Rensburg, 2007). The cultivated forms are useful for producing nutritious grain and foliage, and as colorful ornamentals (Brenner *et al.*, 2000). Amaranth is a source of reach vegetable, it supplies proteins, minerals and essential vitamins (Vitamin C) in the diet. Therefore increasing productivity of Amaranth will increase the nutrient and health status of consumers, thereby improving health status as a result of replacement of animal protein which is high on cholesterol (Sokoto *et al.*, 2012).

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Vegetable products are of importance in human nutrition and they will continue to remain as primary source of energy, lipids and carbohydrates, including fibres, minerals and vitamins in developing countries (Oyolu, 1980; Lima *et al.*, 2009).

The production of minerals and vitamins are limited due to continuous cropping that lead to low soil fertility and eventually affect the plants performance. Amaranth plant has not been well studied when different fertilizer source are used to boost the level of the phytochemical and proximate composition of the plant. In view of the above it is vital to evaluate the performance of Amaranths for their proximate and phytochemical composition using different fertilizer rates so as to enrich the soil to improve performance.

## METHODOLOGY

A field experiment was carried out at the Teaching and Research Farmland of Ibrahim Badamasi Babangida University, Lapai, Niger State, Nigeria. To ascertain the nutrient status of the soil in the study area, soil samples was collected at random from 0-15 cm depth using soil auger before cultivation of the soil. The soil samples were used for physical and chemical analysis in the laboratory using an analytical method. The treatments consisted of two varieties of Amaranthus (*Amaranthus hybridus* L. and *Amaranthus cruentus* L.), five rates of fertilizer (inorganic "NPK" and organic "poultry manure, "0, 20, 40, 2 and 4t/ha") giving a total of 10 treatments combination. The experiment was laid out in a randomized complete block design replicated three times. The size of the plots was 1.2 m × 0.3 m (0.36 m<sup>2</sup>). Each plot contains 3 rows and 3 plant stands per row at spacing of 40 cm inter-row and 10 cm intra-rows.

### Cultural Practices

Cultural practices involved in this research were strictly followed by the methods adopted by Garba *et al.* (2015a). Those practices involved all agronomic practices such as land clearing and preparation, sowing, weeding and fertilizer application.

### Land Clearing and Preparation

The land was cleared of shrubs, grasses and left over of the previous year's materials. At one corner of the experimental site, two

nursery bed was constructed manually with the use of hand hoe and the size of the beds was 3 m by 1.2 m (3.6m<sup>2</sup>), and two varieties of the Amaranths (*Amaranthus cruentus* and *Amaranthus hybridus*) were raised on each beds. Two weeks before transplanting, the land was tilled and made into plot sizes of 2 m × 2 m (4 m<sup>2</sup>) and thereafter, poultry manure (2 and 4 t/ha) and NPK fertilizer 15:15:15 (20 and 40 kg N/ha) was incorporated into the soil based on the treatment designed for the experiment. The crop was transplanted at the permanent site after three weeks from the nursery. The transplanting of *Amaranthus* seedling was done with use of hand trowel by lifting the crop with ball of earth. Weeding was done manually using hand hoe at 2 and 4 weeks after transplanting (WAT).

### Collection of Samples

Collection of sample (stem and leaves) was done manually at the time of harvest, three plants were randomly removed from each experimental plots using kitchen knife. The plants (leaf and stem) were freshly weighed and air dried at room temperature to a constant weight. The sample from each treatment was crushed into powdered form and was analyzed for the determination of phytochemical and proximate composition using standard procedures in the laboratory.

### Data Analysis

Data were analyzed using a one-way analysis of variance (ANOVA) using Statistical Packaging for Social Science (SPSS) version 20.0 software 2011 to test the level of significance ( $p < 0.05$ ). Duncan New Multiple Range Test was used to separate the means where significant differences existed.

### Determination of Proximate Composition of Amaranth

The proximate analysis of two species of Amaranths (*A. hybridus* and *A. cruentus*) on Ash content, Fat, crude protein and crude fibre were determined by the Methods of the Association of Official Analytical Chemist (AOAC, 1990).

Nitrogen Free Extract (NFE) was determined by mathematical calculation. It is obtained by subtracting the sum of percentages of all the nutrients already determined from 100. %NFE = 100-(%moisture + %CF + %CP + %EE + %Ash)

% Moisture =	Weight of sample + dish before drying - Weight of sample+ dish after drying x100
	Weight of sample taken

The moisture content was determined by the loss in weight when the sample was air dried in the laboratory to a constant weight. The fresh leafy sample of varieties of *Amaranthus* spp. is weighed and later air dried in the laboratory and weighed after drying. The drying and weighing continues until a constant weight is achieved.

Since the water content of feed varied widely, ingredients and feed are usually compared for their nutrient content on moisture free or dry matter (DM) basis.

% DM = 100 - % Moisture.

### Determination of Phytochemical Composition of *Amaranthus* spp

Determination of the phytochemical composition (Tannin, Saponin, Alkaloids and Phenols) of the plant was carried out in the Laboratory. Van- Burden and Robison (1981) method was used to determine Tannin, Saponin by Obadoni and Ochuko method (2002), Alkaloids by Harbourne method (1983) and phenol by Spectrophotometric method (AOAC, 2005).

## RESULTS AND DISCUSSION

### Proximate composition of *Amaranthus*

Table 1. presents the proximate composition of two varieties of *Amaranthus* species (*A. hybridus* and *A. cruentus*) such as Ash, Fat, crude protein, crude fibre and Nitrogen free extract (NFE). The result of the one way analysis of variance (ANOVA) revealed that application of 2t/ha significantly ( $p < 0.05$ ) influenced the performance of *A. cruentus* to produced the highest Ash content with mean value  $10.80 \pm 0.10$  and Crude fibre in *A. hybridus* with mean value  $22.70 \pm 0.10$ .

The lowest Ash content and Crude protein were recorded in plots planted with *A.*

*hybridus* at 0 Kg/ha NPK 15:15:15 with mean value  $0.17 \pm 0.15$  and 40 Kg/ha NPK 15:15:15 with mean value  $8.84 \pm 0.33$  respectfully. Inorganic fertilizer (NPK 15:15:15) was observed to have improved the performance of the two *Amaranthus* species in which the application of 20 Kg/ha NPK 15:15:15 recorded the highest Fat and Crude fibre in *A. hybridus* with mean value  $3.50 \pm 0.10$  and  $11.27 \pm 0.25$  respectfully. The lowest Fat and Crude fibre was observed when 40 Kg/ha NPK 15:15:15 was used on *A. hybridus* with a mean value  $2.67 \pm 0.15$  and Crude fibre with mean value  $8.27 \pm 0.15$ . The highest Nitrogen free extract (NFE) was recorded in *A. hybridus* in plots planted without fertilizer application (0 Kg NPK) with mean value  $55.73 \pm 0.17$ . The lowest NFE content was observed where 4 t/ha poultry manure was applied.

The revelation from this research agreed with previous researchers who have reported increase in organic fertilizers on some proximate, mineral contents (Fatima *et al.*, 2007; Funda *et al.*, 2011; Makinde *et al.*, 2010). The work of Oyedeji *et al.* (2014) on proximate composition of three *Amaranthus* species confirmed that Ash content was influenced by poultry manure, higher crude fibre and Fat in *Amaranthus hybridus* was obtained when NPK fertilizer was used compared with poultry manure and the control. Increment in organic materials could have resulted in the ash increment level (Makinde, *et al.*, 2010). Moisture content of the two varieties of *Amaranthus* species showed that, application of 4 t/ha poultry manure produced the highest moisture content in *A. cruentus* with mean value  $85.65 \pm 0.52$ , while plots without fertilizer application with mean value  $72.74 \pm 1.08$  produced the lowest moisture content. The high moisture content of vegetables makes them to aid the digestion of food (Olaiya *et al.*, 2010).

Table 1: Proximate composition of varieties of Amaranth as influenced by NPK and poultry manure.

Treatments	ASH	FAT	CP	CF	NFE	Moisture content
1. <i>A. hybridus</i> with 0 kg NPK	0.17±0.15 <sup>a</sup>	3.10±0.15 <sup>bcd</sup>	19.13±0.01 <sup>b</sup>	9.27±0.15 <sup>c</sup>	55.73±0.17 <sup>e</sup>	80.98±6.65 <sup>abc</sup>
2. <i>A. hybridus</i> with 20 Kg NPK	9.73±0.15 <sup>b</sup>	3.50±0.10 <sup>e</sup>	20.95±0.01 <sup>b</sup>	11.27±0.25 <sup>f</sup>	50.11±0.01 <sup>a</sup>	80.14±3.79 <sup>abc</sup>
3. <i>A. hybridus</i> with 40 Kg NPK	10.10±0.10 <sup>c</sup>	2.67±0.15 <sup>a</sup>	8.84±0.38 <sup>a</sup>	8.27±0.15 <sup>a</sup>	53.18±0.15 <sup>d</sup>	82.20±1.49 <sup>bc</sup>
4. <i>A. hybridus</i> with 2 tons poultry manure	10.45±0.01 <sup>d</sup>	3.13±0.15 <sup>bcd</sup>	22.70±0.10 <sup>b</sup>	8.80±0.10 <sup>b</sup>	50.45±0.02 <sup>a</sup>	74.45±2.80 <sup>ab</sup>
5. <i>A. hybridus</i> with 4 tons poultry manure	10.65±0.15 <sup>ef</sup>	3.13±0.15 <sup>bcd</sup>	22.60±0.10 <sup>b</sup>	8.63±0.15 <sup>b</sup>	50.96±0.01 <sup>ab</sup>	75.45±5.25 <sup>ab</sup>
6. <i>A. cruentus</i> with 0 kg NPK	9.60±0.10 <sup>b</sup>	2.97±0.21 <sup>bc</sup>	17.33±0.01 <sup>b</sup>	8.67±0.15 <sup>b</sup>	53.17±0.21 <sup>d</sup>	72.74±1.08 <sup>a</sup>
7. <i>A. cruentus</i> with 20 Kg NPK	10.44±0.01 <sup>c</sup>	3.30±0.10 <sup>de</sup>	20.08±0.01 <sup>b</sup>	10.60±0.10 <sup>e</sup>	51.93±0.03 <sup>bc</sup>	76.17±8.33 <sup>ab</sup>
8. <i>A. cruentus</i> with 40 Kg NPK	10.44±0.01 <sup>d</sup>	3.10±0.10 <sup>bcd</sup>	20.87±0.01 <sup>b</sup>	9.60±0.20 <sup>d</sup>	52.15±0.13 <sup>c</sup>	78.30±4.60 <sup>abc</sup>
9. <i>A. cruentus</i> with 2 tons poultry manure	10.80±0.10 <sup>f</sup>	2.90±0.10 <sup>b</sup>	22.30±0.10 <sup>b</sup>	9.20±0.10 <sup>c</sup>	51.08±0.15 <sup>ab</sup>	76.85±1.08 <sup>ab</sup>
10. <i>A. cruentus</i> with 4 tons poultry manure	10.60±0.10 <sup>de</sup>	3.15±0.15 <sup>cd</sup>	21.70±0.10 <sup>b</sup>	10.50±0.20 <sup>c</sup>	50.07±0.02 <sup>a</sup>	85.65±0.52 <sup>c</sup>

Means in the same column with different superscripts are significantly different ( $p < 0.05$ )

### Phytochemical Composition of *Amaranthus* species

Table 2. presents the phytochemical composition of *Amaranthus* species such as Tannin, Saponins, Alkaloids and Phenols. The result showed that Alkaloids was influenced by poultry manure at the rate of 2 t/ha in plots planted with *A. hybridus* with mean value of  $4.96 \pm 0.01$ , while the lowest Alkaloids was recorded in *A. hybridus* in the plots without fertilizer. *A. hybridus* with the application of 20 and 40 Kg NPK 15:15:15 produced the highest Saponin with mean value of  $0.95 \pm 0.03$  and Tannin with mean value of  $0.55 \pm 0.01$ . The

lowest Saponin and Tannin composition of *Amaranthus* spp was recorded in *A. hybridus* at 4 t/ha and 0 Kg NPK respectfully. Application of 20 Kg NPK 15:15:15 also produced the highest phenols with mean value  $1.80 \pm 0.10$  and the lowest been  $0.18 \pm 0.01$  in plots without fertilizer application. The result in this regard showed that NPK 15:15:15 play greater role compared to poultry manure, This could be as a result of delayed in nutrient mineralization of poultry manure which lead to lower utilization of the nutrients by the plant resulting in low phytochemical composition.

Table 2. Phytochemical composition of varieties of Amaranth as influenced by NPK and poultry manure.

Treatments	Tannin	Saponins	Alkaloids	Phenols
1. <i>A. hybridus</i> with 0 kg NPK	$0.28 \pm 0.01^a$	$0.76 \pm 0.03^e$	$4.34 \pm 0.01^d$	$0.18 \pm 0.01^a$
2. <i>A. hybridus</i> with 20 Kg NPK	$0.33 \pm 0.01^b$	$0.95 \pm 0.03^i$	$4.49 \pm 0.01^e$	$0.66 \pm 0.01^d$
3. <i>A. hybridus</i> with 40 Kg NPK	$0.55 \pm 0.01^f$	$0.92 \pm 0.01^h$	$4.70 \pm 0.10^f$	$1.40 \pm 0.10^e$
4. <i>A. hybridus</i> with 2 tons poultry manure	$0.38 \pm 0.02^c$	$0.54 \pm 0.03^b$	$4.96 \pm 0.01^i$	$0.35 \pm 0.01^b$
5. <i>A. hybridus</i> with 4 tons poultry manure	$0.41 \pm 0.01^d$	$0.48 \pm 0.02^a$	$4.87 \pm 0.01^h$	$0.39 \pm 0.01^a$
6. <i>A. cruentus</i> with 0 kg NPK	$0.31 \pm 0.01^b$	$0.64 \pm 0.01^c$	$2.80 \pm 0.10^d$	$0.22 \pm 0.01^a$
7. <i>A. cruentus</i> with 20 Kg NPK	$0.43 \pm 0.03^d$	$0.82 \pm 0.01^f$	$3.35 \pm 0.02^b$	$1.80 \pm 0.10^g$
8. <i>A. cruentus</i> with 40 Kg NPK	$0.49 \pm 0.01^e$	$0.85 \pm 0.02^g$	$4.17 \pm 0.02^c$	$1.65 \pm 0.01^g$
9. <i>A. cruentus</i> tons poultry manure	$0.36 \pm 0.01^c$	$0.56 \pm 0.01^b$	$4.64 \pm 0.01^f$	$0.43 \pm 0.01^b$
10. <i>A. cruentus</i> with 4 tons poultry manure	$0.36 \pm 0.01^c$	$0.68 \pm 0.01^d$	$4.79 \pm 0.01^g$	$0.55 \pm 0.01^{c-}$

Means in the same column with different superscripts are significantly different ( $p < 0.05$ ).

### Conclusion

The result of this study revealed that NPK 15:15:15 and Poultry manure played a greater role in providing more nutrients for the growth of *Amaranthus* spp. The proximate compositions were more influenced by poultry manure, while the phytochemical analysis indicated that the compositions were more influenced by inorganic fertilizer (NPK). The reason could be as a result of slow mineralization of poultry manure which may have resulted to lower utilization of the nutrients by the plant species. It is therefore recommended that, further study should be carried out by other researchers to confirm and compare the results.

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