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INFLUENCE OF NITROGEN FERTILIZER AND POULTRY MANURE ON GROWTH OF AMARANTHS (*Amaranths cruentus*) IN BADEGGI, NIGER STATE, NIGERIA

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Abstract
Field experiment were conducted to determine the influence of nitrogen fertilizer and poultry manure on growth of Amaranths (Amaranths cruentus) at the research farm of National Agriculture Extension Research Liaison Service (NAERLS/ABU) out station Badeggi, Niger State, Nigeria, in 2021 and 2022 rainy season were assessed. The treatments were laid out in a split-split plot design replicated three times. The nitrogen fertilizer and poultry manure were assigned to sub-plot and sub-sub plot respectively while the combination (nitrogen + poultry manure) was assigned to the main plot. Plot size of 35.5m long and 25.5m with four levels of nitrogen rates (0kgN/ha, 40kgN/ha, 80kgN/ha, 120kgN/ha and four level of poultry manure PM (0t/ha, 5t/ha, 3.75t/ha, 10t/ha) while combination of nitrogen + poultry manure had four levels 0kgN/ha +0t/ha, 20kgN/ha +2.5t/ha, 40kgN/ha +3.75t/ha, 60kgN/ha +5t/ha respectively. Result indicated significant difference (P<0.05) among application treatment at 6WAS week after sowing, tallest plant height 56.27cm was recorded in 2021 cropping season on plot where 120kgN/ha was applied while tallest plant height of 54.23cm was recorded in 2022 wet season. Significant effect of application where recorded at 2, 4, 6 weeks after sowing WAS. Highest results recorded were 71.43cm for plant height, 133.03(insert unit) for leaves area, 34.83 for number of leaves and 7.50cm for stem diameter. From the experiment, plot amended with 60kgN/ha in combination with 5t/ha of poultry manure resulted in higher yield of Amaranths in Badeggi, Southern Guinea Savanna Agro-ecological zone of Nigeria.
Keywords: Amendment, Combination, Cropping, Levels and Nutrients.

Introduction

Amaranths cruentus is a leafy vegetable commonly cultivated in Nigeria and many parts of sub-Sahara Africa (Muhammad *et al.,* 2017). It belongs to the family *Amaranthaceae* and consist of 60 species (Achigan-Dako, *et al.,* 2014). Amaranths are grown for their leaves and grains which are good source of minerals and vitamin (Assad *et al.,* 2017). Despite their importance in human diets, production of Amaranths in Nigeria is low (Arowosegbe *et al.,* 2018). The main factors that prevents adequate cultivation of amaranths is believed to be poor soil fertility and scarcity of fertilizers for soil fertility management (Olaniyi *et al.,* 2008).

Nigeria soils are highly degraded due to unsustainable management techniques and absence of appropriate soil fertility restoration practice (FMARD, 2022). Soil fertility management using inorganic fertilizers proved to be difficult since inorganic fertilizers are costly and scarce (Shehu, *et al.,* 2019). Poultry manure if applied on soil provides essential nutrients for cultivating crops and improves soil quality as well (Ainika and Amans, 2011). Application of organic amendments along with inorganic fertilizers is a common practice by vegetable farmers in many parts of Nigeria (Ahmad *et al.,* 2019). According to Oyedeji *et al.,* (2014) application of inorganic fertilizer combined with poultry manure improved the growth and yield of amaranths in North-Western Nigeria. To derived maximum benefits of sole and combined application of organic and inorganic fertilizers, it is necessary to assess the soil fertility of an area. Unfortunately, there are some information gaps regarding the appropriate combination levels of organic and inorganic fertilizers on growth of *Amaranths cruentus* in many parts of Nigeria (Oyedeji *et al.,* 2014). This

study was therefore conducted to assess the influence of different levels of nitrogen fertilizer rates, poultry manure and their combinations on the growth of *Amaranths cruentus* in Badeggi, Southern Guinea Savanna Agro-ecological zone of Nigeria.

Materials and Methods

Study Site

The experiment was conducted at the research farm of National Agriculture Extension Research and Liaison Services (NAERLS/ABU) outstation, Badeggi, Niger State during the wet season 2021 and 2022 cropping season located between $90^0$45'N and longitude $60^0$45'E with altitude of 420m above sea level (Ladan *et al.,* 1989).

Soil Sampling and Poultry Manure Analysis

The experimental site was cleared, ploughed and harrowed twice to obtain fine tilth. Soil samples were collected at the depth of 0-30cm at the experimental site farm before sowing and the soil samples were analyzed for physical and chemical properties following the procedure outlined by Agbenin, (1995). The poultry manure was also analyzed before application for chemical and physical composition.

Agronomic Practices

The entire land area was 35.5cm x 25.5m. The land was ploughed and harrowed. The treatment and experimental design were laid out in a split-split plot design replicated three times. The nitrogen fertilizer and poultry manure (PM) were assigned to sub-plot and sub-sub plot, while combination of (nitrogen fertilizer + poultry manure) was assigned to the main plot. The treatment consists of four nitrogen levels (0kgN/ha, 40kgN/ha, 80kgN/ha and 120kgN/ha) and PM consisting of four poultry manure levels (0t/ha, 5t/ha, 7.5t/ha and 10t/ha) respectively. While the combination (nitrogen + poultry manure) also have four level treatments (0kgN/ha +0t/ha, 20kgN/ha +2.5t/ha, 40kgN/ha +3.75t/ha, 60kgN/ha +5t/ha). Twelve treatment with thirty-six (36) plots. Each plot measured 3m x 3m and was separated from the other by 1m path and 0.5m gap between the replication.

The *Amaranths cruentus* (Sam/A21) seeds used was obtained from IAR/ABU, Zaria. Prior to planting, the experimental field was sprayed with Karate EC25 and *Amaranths cruentus* seeds were sown at a distance of 30cm x 30cm and later thinned to one plant per stand two weeks after sowing (2 WAS). Weeding was done manually after every two weeks. Dimethoate 400EC was applied at the concentration of 1.5L at the 2WAS, 4WAS, weeks after sowings (Bako *et al.,* 2021) used to control insect pest on the experimental plots. The PM treatments were incorporated two weeks before the crops were sown, while nitrogen was applied one week after sowing (Abayomi and Adebayo, 2014).

Growth Parameters

The growth components studied were plant height determined by measuring the height of each tagged plant from the soil level to the tip of the plant terminal tip and number of leaves per plant that was obtained by counting all functional leaves per plant on the tagged plants. Others were leaf area which was determined using Salam *et al.,* (2008) method with a correction factor of 0.64 and stem diameter that was determined by using Vernier Caliper. Data were recorded at 2WAS, 4WAS and 6WAS weeks after sowing.

Statistical Analysis
Data collected were subjected to analysis of variance and significant means were separated using Duncan Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion
Physical and Chemical Properties of the Soil before sowing
Table 1 present results of physical and chemical properties of the soil prior to sowing. The result indicated that the soil texture of the experimental site was sandy loamy. The surface soil was predominantly sandy 642%, silt and clay particles were 122% and 236% respectively for 2021 cropping season. While the surface soil was also predominantly sandy 620%, silt and clay particles were 130% and 250% for 2022 cropping season. Low in nitrogen content and the soil reaction (pH) was moderately acidic (Hazelton and Murphy, 2007).
Moderate soil reaction provides appropriate medium for maximum microbial activities with higher rate of bio-recycling of organic materials (Alexandra and Jose, 2005). Electrical conductivity was also low and has less tendency for excess salts accumulation on the surface soil (Alhassan *et al.,* 2018). The soil was low in Calcium, Potassium and Magnesium as shown in table in Table 1.

Table 1: Physical and Chemical Properties of the Soils before Sowing

Parameter	**Value**	
Parameter	2021	2022
Clay (g/kg^{-1})	236	250
Silt (g/kg^{-1})	122	130
Sand (g/kg^{-1})	642	620
Texture Classes	Sandy Loam	Sandy Loam
Chemical Properties		
pH (H_2O: 1:2.5 w/v)	5.70	6.20
pH (0.01M$CaCl_2$ 2.5 w/v)	6.50	6.80
Exchange Acidity (Cmol/kg soil)	0.07	0.08
Electrical Conductivity (mg/kg)	0.8	0.9
Bray P (mg/kg)	6.60	6.90
Organic Carbon (g/kg)	4.20	4.70
Total N (g/kg)	0.17	0.24
Exchangeable Cation (Cmol/kg)		
Kg (Cmol/kg)	0.19	0.25
Ca (Cmol/kg)	4.17	5.45
Mg (Cmol/kg)	0.47	0.95
Na (Cmol/kg)	0.25	0.33
CECK (Cmol/kg)	5.85	6.85
Extract Micro Nutrients (Cmol/kg)		
Zinc Zn	6.27	6.75
Sodium Absorption Ratio	0.08	0.09
Sodium Base Saturation (PBS)	85.35	92.84

Source: Soil sample as analyzed by Soil Dept., Federal University of Technology, Minna

Chemical Properties of Poultry used in the Experiment

Table 2 shown the nutrient content of organic manure (poultry manure) used in the study. The poultry manure was slightly acidic. The organic matters, total nitrogen and available phosphorus contents recorded were 18.9 (insert the unit), 3.8 (insert the unit) and 1.7 (insert the unit) in 2021 cropping season while the 2022 wet season had 19.75(insert the unit), 4.3(insert the unit) and 2.3(insert the unit). The value of Ca, K, Mg were higher in 2022 than the 2021 cropping season. This clearly showed that poultry manure dropping was rich in nutrient for the two-wet season. The Na, Zn, Mn, concentration was low in both wet seasons.

Table 2: Chemical Properties of the Poultry Manure used for the Experiment

Parameter	**Value**	
Parameter	2021	2022
Organic Carbon (g/kg)	18.9	19.75
Total N (g/kg)	3.8	4.3
Available P, (mg/kg)	1.7	2.3
Kg+	15.9	17.5
Ca^{2}+	23.1	23.7
Mg^{2}+	3.9	5.3
Na+	2.8	3.1
Ca	12.0	15.7
Mn	0.7	0.8

Source: Poultry Manure as analyzed by Soil Dept., Federal University of Technology, Minna

Plant Height

Table 3 Influence of Nitrogen Fertilizer and Poultry Manure on plant height (cm) of Amaranths (*Amaranthus cruentus*) during 2021 and 2022 Wet Season at Badeggi revealed the application of nitrogen fertilizer and poultry manure had significant influenced on the height of *A. cruentus* during the six weeks of sowing. At two weeks after sowing (2WAS), tallest height of 17.90cm was recorded in 2022 cropping season on plots where 120kgN/ha was applied. For 4WAS of the two seasons, tallest height of 31.20cm and 35.90cm were recorded on plot amended with (40kgN/ha+3.75t/ha and 60kgN/ha+5t/ha PM respectively. At the six week (6WAS) after sowing of the two seasons, tallest height of 61.57cm and 71.43cm were recorded on plots amended with 40kgN/ha+3.75t/ha PM and 60kgN/ha+5t/ha PM respectively. From the combined means at the 6WAS tallest *A. cruentus* height of 68.70cm was recorded on plot amended with 40kgN/ha+3.75t/ha PM, followed by height of 67.40cm recorded on plot amended with poultry manure at rate of 10t/ha PM. The result indicates that *A. cruentus* heights were produced on plot amended with combination of nitrogen fertilizer and poultry manure compared to the sole applications of either of the two fertilizers. This view is in tandem with findings earlier reported by Tongos, (2016). In another experiment, Kahu *et al.,* (2019) reported that application of poultry manure combined with NPK fertilizer had significant effect on growth of *A. cruentus* compared to single application of either poultry manure or NPK fertilizer. The taller heights of *A. cruentus* recorded could be attributed to release of nutrients from the combined fertilizers which resulted in high nutrients availability and uptake with the ultimate production of taller amaranths, which agree with the findings of Olowoake and Ojo, (2014), Abayomi and Adebayo, (2014) as well as Ahmad *et al.* (2019).

Table 3: Influence of Nitrogen Fertilizer and Poultry Manure on plant height (cm) of Amaranths (*Amaranthus cruentus*) during 2021 and 2022 Wet Season at Badeggi

TREATMENTS	2WAS			4WAS			6WAS		
	2021	2022	C.M	2021	2022	C.M	2021	2022	C.M
Nitrogen (N)									
0kgN/ha	14.87^{d}	15.50^{c}	15.19^{c}	28.07^{c}	13.67^{d}	20.87^{b}	56.27^{d}	54.23^{b}	28.14^{a}
40kgN/ha	15.13^{cd}	15.17^{c}	15.15^{f}	29.57^{bc}	31.50^{ab}	30.37^{e}	64.60^{ab}	62.80^{ab}	63.74^{d}
80kgN/ha	17.00^{b}	15.73^{bc}	16.37^{cd}	28.17^{de}	32.20^{abc}	30.67^{d}	62.80^{abc}	62.87^{ab}	62.39^{e}
120kgN/ha	16.33^{ab}	17.90^{a}	17.12^{a}	29.70^{abcd}	38.67^{ab}	34.19^{b}	60.33^{bcd}	61.97^{ab}	58.82^{f}
Poultry (PM)									
0t/pm	13.76^{d}	14.40^{c}	14.18^{c}	27.07^{c}	12.67^{d}	20.76^{b}	55.17^{d}	53.13^{b}	27.14^{c}
5t/pm	16.13^{abc}	16.53^{abc}	16.33^{d}	29.77^{abc}	30.37^{c}	30.07^{f}	58.87^{cd}	57.30^{ab}	59.27^{f}
7.5t/pm	15.13^{cd}	17.73^{ab}	16.43^{c}	29.20^{bcde}	29.70^{c}	29.45^{e}	64.10^{ab}	59.67^{ab}	61.85^{c}
10t/pm	16.13^{abc}	16.80^{abc}	16.47^{c}	29.57^{bcde}	31.83^{bc}	30.70^{d}	62.63^{abc}	59.60^{ab}	67.40^{b}
Combined (N+P)									
0kgN + 0t/pm	14.35^{d}	15.20^{c}	15.07^{c}	27.09^{c}	13.27^{d}	20.03^{b}	55.15^{d}	53.13^{b}	27.65^{b}
20kgN + 2.5tons/pm	16.14^{abc}	17.13^{abc}	16.64^{b}	30.37^{a}	29.27^{c}	30.17^{c}	64.93^{ab}	72.17^{a}	66.68^{a}
40kgN + 3.75tons/pm	16.07^{acd}	17.17^{abc}	16.62^{b}	31.80^{a}	35.90^{abc}	30.05^{c}	65.97^{a}	69.13^{ab}	68.70^{o}
60kgN + 5t/tons/pm	15.47^{bcd}	16.80^{abc}	16.14^{c}	28.80^{cde}	41.00^{a}	34.90^{a}	61.57^{abc}	71.43^{a}	57.90^{g}
S.E	0.47	1.03	0.04	0.73	3.75	0.11	2.43	7.11	0.23

All values with same letters are not significantly different at 0.05% level using Duncan Multiple Range Test (t)
C.M = Combined Mean; N = Nitrogen Fertilizer; PM = Poultry Manure

Leaf Area

Table 4 Influence of Nitrogen Fertilizer and Poultry Manure on Leaf Area (mm^2) of Amaranths (*Amaranthus cruentus*) during 2021 and 2022 Wet Season at Badeggi. The application of nitrogen fertilizer and poultry manure. had significant influenced on the Leaf Area of *A. cruentus*. At 2WAS in 2021 cropping season experiment, largest leaf area of 14.46mm^2 was recorded on plots amended with 20kgN/ha+2.5t/ha PM/ha. For 2022 season, sole application of 120kgN/ha nitrogen fertilizer produced largest leaf area of 16.21mm^2. At 4WAS in 2021 season, largest leaf area of 98.80mm^2 was recorded on plots where 80kgN/ha nitrogen fertilizer was applied. Similarly, the application of 80kgN/ha nitrogen fertilizer did not have significant differences (P>0.05) with plots amended with 60kgN/ha nitrogen +3.7t/ha PM. At 6WAS of the 2021 cropping season, largest leaf area of 91.60mm^2 was recorded on plots amended with 10 tons PM/ha. For the 2022 cropping season, largest leaf area of 133.05mm^2 was recorded on plot amended with 60kgN/ha nitrogen +5t/ha PM. The smallest leaf area (58.52mm^2) was recorded from the control plots. The results show larger leaves of *A. cruentus* were recorded on plots amended with combined application of nitrogen and poultry manure at higher rates and is similar with the trend earlier observed for the height of *A cruentus* and this observation also agrees with findings of earlier studies (Adewole and Dedeke, 2012; Ahmad *et al.,* 2019). The larger Leaf Area recorded could be attributed to release of nutrients and higher nutrient uptake in nitrogen combined with poultry manure. Larger leaves are expected to increase the ability of *A. cruentus* for higher sunlight absorption, thereby facilitating higher photosynthetic activity which was accompanied with fast assimilates production (Richard *et al.,* 2019). Larger leaves could also mean more weight value with likely income for producers (Kahu *et al.,* 2019).

Table 4: Influence of Nitrogen Fertilizer and Poultry Manure on Leaf Area (mm^2) of Amaranths (*Amaranthus cruentus*) during 2021 and 2022 Wet Season at Badeggi

TREATMENTS	2WAS			4WAS			6WAS		
	2021	2022	C.M	2021	2022	C.M	2021	2022	C.M
Nitrogen (N)									
0kgN/ha	13.47^{d}	13.10^{b}	13.29^{b}	43.00^{a}	27.52^{c}	35.26^{f}	69.75^{b}	47.29^{bc}	58.52^{b}
40kgN/ha	13.98^{abcd}	13.63^{ab}	13.81^{f}	42.12^{ab}	47.03^{bc}	44.58^{b}	77.23^{ab}	71.59^{c}	74.41^{c}
80kgN/ha	13.68^{bcd}	16.21^{a}	14.95^{a}	51.39^{a}	49.55^{bc}	50.47^{g}	67.40^{b}	44.02^{bc}	55.71^{e}
120kgN/ha	14.14^{abc}	13.30^{ab}	33.74^{fg}	43.29^{ab}	40.30^{bc}	41.80^{e}	77.45^{ab}	67.64^{bc}	72.55^{e}
Poultry (PM)									
0t/pm	12.37^{e}	13.05^{c}	13.03^{ab}	41.13^{a}	28.52^{b}	34.13^{c}	68.65^{b}	49.15^{cd}	57.33^{ed}
5t/pm	14.14^{abc}	13.30^{ab}	13.74^{fg}	43.29^{ab}	40.30^{bc}	41.80^{e}	77.45^{ab}	67.64^{bc}	72.55^{e}
7.5t/pm	13.66^{cd}	15.86^{ab}	14.69^{b}	46.38^{ab}	50.17^{bc}	48.28^{e}	59.45^{b}	84.20^{ab}	71.83^{g}
10t/pm	13.84^{bcd}	13.49^{ab}	13.67^{g}	47.44^{ab}	94.86^{a}	71.15^{b}	91.60^{a}	69.40^{bc}	80.50^{b}
Combined (N+P)									
0kgN + 0t/pm	13.27^{c}	13.05^{b}	13.13^{b}	42.85^{a}	27.42^{d}	34.16^{f}	69.95^{b}	46.19^{bc}	57.42^{c}
20kgN + 2.5tons/pm	14.46^{a}	13.46^{ab}	13.96^{c}	46.40^{ab}	56.05^{b}	51.45^{e}	73.65^{ab}	70.77^{bc}	72.21^{f}
40kgN + 3.75tons/pm	14.17^{abc}	14.12^{ab}	14.15^{d}	50.40^{ab}	63.54^{b}	56.97^{d}	67.16^{b}	81.48^{ab}	74.32^{e}
60kgN + 5t/tons/pm	12.26^{ab}	14.42^{ab}	13.34^{b}	45.16^{ab}	94.90^{a}	70.03^{e}	76.50^{ab}	133.05^{a}	104.78^{o}
S.E	0.27	1.37	0.03	3.70	6.53	0.06	8.93	27.01	0.07

All values with same letters are not significantly different at 0.05% level using Duncan Multiple Range Test (t)
C.M = Combined Mean; N = Nitrogen Fertilizer; PM = Poultry Manure;

Number of Leaves

Influence of Nitrogen Fertilizer and Poultry Manure on Number of Leaves of Amaranths (*Amaranthus Cruentus*) during 2021 and 2022 Wet Season at Badeggi as presented in table 5. The significant influenced of the treatment were observed on number of leaves of *A. cruentus*. Application of 60kgN/ha+5t/ha PM/ha produced highest leaves number of 6.33, 7.33 and 6.83 for the 2021 and 2022 cropping season as well as the combined means at the 2WAS. At 4WAS, application of 40kgN/ha+3.75t/ha PM produced highest leaves number of 19.17, 22.27 and 20.72 for the two seasons and their combined means respectively. At 6WAS in 2021 cropping season, the highest leaves number of 28.27 was recorded on plots amended with sole application of poultry manure at the rate of 10 tons PM/ha. In 2022 cropping season, highest leaves number of 34.83 was recorded on plots amended with 60kgN/ha nitrogen + 5t/ha PM.

The influenced of applied treatments on leaves number indicates an increase in leaves number with higher rates of the applied fertilizers and also progressively increased with days after sowing. Combined application of the fertilizers also produced higher leaves number compared to the sole application of poultry manure or nitrogen fertilizer. The findings of this research are in agreement with the report of Pospisil, *et al.,* (2006). The number of leaves observed in this experiment was higher than what was earlier reported by Tongos, (2016) and Ahmad et al., (2019) for the application of single dose of nitrogen fertilizer and NPK. However, Bako *et al.,* (2021) recorded higher leaves number of *Amaranthus hybridus* amended with 300kgN/ha solid compost combined with NPK in soil of Bida. The increase in number of leaves with combined fertilizer application of the two fertilizers, confirmed that the combination released more essential nutrients compared to sole application and as such promotes vigorous vegetative growth and larger leaves number of *A. cruentus* due to higher nutrients uptake (Olaniyi, *et al.,* 2008).

Table 5: Influence of Nitrogen Fertilizer and Poultry Manure on Number of Leaves of Amaranths (*Amaranthus Cruentus*) during 2021 and 2022 Wet Season at Badeggi

TREATMENTS	2WAS			4WAS			6WAS		
	2021	2022	C.M	2021	2022	C.M	2021	2022	C.M
Nitrogen (N)									
0kgN/ha	5.06^{c}	5.53^{b}	5.31^{d}	15.31^{b}	14.93^{b}	14.62^{c}	25.33^{d}	24.82^{e}	24.22^{f}
40kgN/ha	5.73^{b}	6.10^{a}	5.92^{e}	18.40^{ab}	19.93^{ab}	19.17^{d}	27.73^{ab}	28.17^{ab}	27.95^{e}
80kgN/ha	6.07^{ab}	7.10^{a}	6.59^{bc}	17.40^{bc}	18.63^{ab}	18.02^{f}	27.80^{ab}	29.47^{ab}	28.64^{b}
120kgN/ha	6.40^{ab}	7.57^{a}	6.75^{a}	19.13^{a}	20.33^{ab}	19.73^{b}	26.27^{b}	25.80^{b}	26.04^{c}
Poultry (PM)									
0t/pm	5.35^{ab}	5.75^{c}	5.53^{ab}	16.42^{e}	15.73^{g}	15.62	26.37^{c}	25.75^{d}	25.35^{e}
5t/pm	5.47^{ab}	7.57^{a}	6.52^{c}	18.40^{ab}	18.07^{e}	18.24^{ab}	27.27^{ab}	32.43^{ab}	29.85^{c}
7.5t/pm	6.40^{b}	6.67^{a}	6.54^{b}	17.20^{bc}	16.67^{g}	16.94^{g}	27.20^{ab}	30.97^{ab}	29.09^{d}
10t/pm	5.47^{ab}	6.50^{a}	5.99^{e}	19.93^{abc}	19.60^{d}	18.77^{d}	28.27^{a}	27.33^{ab}	27.80^{g}
Combined (N+P)									
0kgN + 0t/pm	5.95^{b}	6.05^{b}	5.92^{c}	16.42^{d}	15.75^{b}	15.82^{c}	25.27^{c}	25.97	25.73^{c}
20kgN + 2.5tons/pm	6.07^{cb}	7.17^{O}	6.62^{b}	16.87^{c}	15.37^{bc}	16.12^{h}	28.07^{ab}	31.97^{ab}	30.02^{b}
40kgN + 3.75tons/pm	6.00^{ab}	7.07^{a}	6.54^{b}	19.17^{a}	22.27^{a}	20.72^{a}	26.80^{ab}	33.27^{ab}	30.04^{b}
60kgN + 5t/tons/pm	6.33^{a}	7.33^{a}	6.83^{a}	17.27^{ab}	22.33^{a}	19.80^{b}	27.87^{ab}	34.85^{a}	31.35^{a}
S.E	0.45	1.02	0.05	0.66	2.41	0.04	0.88	4.01	0.03

All values with same letters are not significantly different at 0.05% level using Duncan Multiple Range Test
C.M = Combined Mean; N = Nitrogen Fertilizer; PM = Poultry Manure;

Stem Diameter

Table 6 Influence of Nitrogen Fertilizer and Poultry Manure on Stem diameter of Amaranths (*Amaranthus Cruentus*) during 2021 and 2022 Wet Season at Badeggi shows that the application of nitrogen fertilizer and poultry manure had significant influenced on stem diameter of *A. cruentus*. At 2WAS in 2021 cropping season, largest stem diameter of 2.87cm was recorded on plot amended with 40kgN/ha +2.5t/ha PM. In 2022 cropping season of same two weeks, largest diameter of 3.15cm was recorded on plots amended with 60kgN/ha + 5t/ha PM. At 4WAS 2021 season, largest stem diameter of 3.60cm was recorded on plots amended with 60kgN/ha+5t/ha PM.

During the 6WAS in 2021 season, largest stem diameter of 6.67cm was recorded on plots amended with 60kgN/ha+5t/ha Pm.

Generally, combined applications of nitrogen fertilizers and poultry manure produced larger stem diameter similar with earlier trends for other growth parameters. The result agrees with the finding of Tongos *et al.* (2018). The larger stem diameter recorded with the combined application at higher rates of the combined fertilizers could be attributed to balance release of nutrients due to the combination of Nitrogen fertilizer and poultry manure (Muhanmad, *et al.,* 2017).

Table 6: Influence of Nitrogen Fertilizer and Poultry Manure on Stem diameter of Amaranths (*Amaranthus Cruentus*) during 2021 and 2022 Wet Season at Badeggi

TREATMENTS	2WAS			4WAS			6WAS		
	2021	2022	C.M	2021	2022	C.M	2021	2022	C.M
Nitrogen (N)									
0kgN/ha	2.47^{b}	2.93^{e}	2.77^{c}	3.40^{d}	2.33^{b}	2.83^{e}	4.95^{e}	5.35^{b}	5.15^{c}
40kgN/ha	2.40^{b}	3.47^{ab}	2.94^{c}	3.53^{a}	3.90^{abc}	3.72^{c}	5.43^{bc}	6.17^{abc}	5.80^{cd}
80kgN/ha	2.71^{ab}	3.27^{ab}	2.99^{cb}	3.57^{a}	3.87^{abc}	3.72^{c}	5.53^{bc}	6.10^{abc}	5.82^{cd}
120kgN/ha	2.78^{ab}	3.60^{ab}	3.19^{a}	3.33^{a}	4.67^{ab}	4.00^{a}	5.37^{c}	6.10^{abc}	5.74^{d}
Poultry (PM)									
0t/pm	2.32^{b}	3.03^{b}	3.61^{e}	3.40^{d}	2.33^{c}	2.96^{g}	5.35^{b}	5.75^{bc}	5.45^{c}
5t/pm	2.57^{ab}	2.87^{ab}	2.72^{d}	3.27^{a}	3.73^{abc}	3.50^{de}	5.43^{bc}	6.07^{abc}	3.75^{d}
7.5t/pm	2.59^{ab}	3.20^{ab}	2.90^{c}	3.50^{a}	3.53^{abc}	3.52^{d}	5.37^{c}	6.23^{abc}	5.80^{cd}
10t/pm	2.47^{ab}	2.67^{b}	2.57^{e}	3.30^{a}	3.40^{abc}	3.35^{f}	5.30^{c}	5.67^{bc}	5.49^{e}
Combined (N+P)									
0kgN + 0t/pm	2.30^{b}	2.84^{c}	2.68^{cd}	3.41^{a}	2.92^{c}	2.84^{g}	5.60^{b}	5.83^{bc}	5.65^{c}
20kgN + 2.5tons/pm	2.51^{ab}	2.93^{ab}	2.72^{d}	3.40^{a}	3.47^{abc}	3.44^{e}	5.57^{c}	7.13^{a}	6.35^{b}
40kgN + 3.75tons/pm	2.87^{a}	3.28^{ab}	3.08^{ab}	3.60^{a}	3.10^{bc}	3.35^{f}	5.33^{c}	7.50^{a}	6.42^{b}
60kgN + 5t/tons/pm	2.47^{ab}	3.83^{a}	3.15^{o}	3.60^{a}	5.33^{a}	4.47^{o}	6.67^{a}	6.40^{abc}	6.54^{c}
S.E	0.19	0.55	0.06	0.16	0.90	0.04	0.16	0.75	0.06

All values with same letters are not significantly different at 0.05% level using Duncan Multiple Range Test (t)
C.M = Combined Mean; N = Nitrogen Fertilizer; PM = Poultry Manure;

Conclusion

This study was conducted to assess the influence of different levels of nitrogen fertilizer rates, poultry manure and their combinations on the growth of *Amaranths cruentus* in Badeggi, Southern Guinea Savanna Agro-ecological zone of Nigeria". The result shows varying fertilizer rates has influence on *A. cruentus. Application of 80kg N/ha enhance the growth. The levels of poultry manure have influences on A. cruentus at various levels but the combinations significantly influence A. cruentus yield.* Based on the result of the experiments, application of 60kgN/ha + 5t/ha PM is recommended for the cultivation of *A. cruentus* at Badeggi, Niger State, Southern Guinea Savanna Agro Ecological Zone of Nigeria. Sole application of 10t/ha poultry manure is also recommended for organic cultivation of *A. cruentus* in the study area.

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