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NUTRITIONAL COMPOSITION OF FLUTED PUMPKIN LEAVES (*Telfairia occidentalis* HOOK F.) AS AFFECTED BY FOUR DIFFERENT RATES OF UREA FERTILIZER IN UNWANA-AFIKPO, EBONYI STATE

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Abstract
The nutritional composition of Fluted Pumpkin leaves (Telfairia occidentalis Hook F.) as affected by four different rates of Urea fertilizer in Unwana-Afikpo was conducted at the research farm of Department of Horticulture and Landscape Technology, Akanu Ibiam Federal Polytechnic, Unwana. The area is in a humid tropical agro-ecological zone. The objective was to evaluate the nutritional composition under different urea fertilizer rates. The study was laid out in a randomized complete block design (RCBD) replicated three (3) times. Each replicate was made up of four (4) plots. Treatments include urea fertilizer rates of 0, 40, 80 and 120kg. Proximate data collected on the fluted pumpkin leaves at 12 weeks after planting (WAP) were; carbohydrate, crude protein, crude fiber, crude fat and moisture content. Analysis of variance results (ANOVA) indicate that the distribution of carbohydrate, crude protein and other nutrients in the fluted pumpkin leaves was influenced by urea fertilizer. 80kgN/ha produced more carbohydrate (4.96%), more crude protein (12.01%) and more crude fiber content (5.38%) while control plots recorded the least values on all parameters assessed. On the other hand, when the urea fertilizer was increased beyond 80kg/ha, there was declined in the nutritional composition except on crude fat and moisture content with 2.61% and 75.02%, respectively. However, we recommend 80kg/ha of urea fertilizer for better improvement on the nutritional composition of fluted pumpkin leave in Unwana-Afikpo.

Keywords
Application Rates, Fluted Pumpkin, Nutrient Composition, Urea Fertilizer

Introduction

Fluted pumpkin belongs to the family "Cucurbitaceae" and is dicotyledonous crop which are distributed all over the world (Okoli & Mgbeogwu, 1983). The family has 90 general and more than 700 species (Axtela, 1992). In Nigeria, there are two major cultivars; Ugu ala with dark/black red seeds and Ugu elu with brown/yellowish seed (Odinaka and Schippers, 2004).

The conventional method of propagation is by seed sown directly at the rate of 3,000 to 7,000 seeds/ha and spaced at 0.3 to 1m (Ossom, 1986). NIHORT (1998) recommended 40,000 plants per hectare for fruit production. About 1.9tons of seeds can be derived from 3,000 fruits of fluted pumpkin (Akoroda, 1990b). Ossom et al.(2005) reported that *Telfairia occidentalis* thrives well within the temperature range of 30 to 50^0C.

The nutritional value of fluted pumpkin can never be over emphasized. The leaf of fluted pumpkin has high iron and protein content. According to FAO (1988), leaves and edible shoots together contains 85% moisture and dry protein which is usually consumed contains 11% crude protein, 25% carbohydrate, 3% oil, 11% ash and as much as 700ppm of iron. FAO (1988) reported that the nutritional values of fluted pumpkin leaves contains 86ml water, 47 calories, 2.9g protein, 1.8g fat, 7.0g carbohydrate and 1.7g fibres.

In field trial on the growth, yield and nutritional composition of fluted pumpkin as affected by fertilizer types in Ogbomoso, FAO (1988) reported that the nutritional value of pumpkin seeds is different from that of the leaves. They found that the protein contents of seeds and leaves are 20.5g and 2.5g, respectively, and showed that the seeds have high nutritive and calorific values, which make them necessary in diets. Akanbi et al. (2006) noted that the leaf is of high nutritional, medicinal and industrial values rich in protein (29%), fat (18%) and minerals and vitamins (20%). Soil fertilization is one of the main factors increasing yield of plants (Kolodziej, 2006). Nitrogen plays a role in chlorophyll synthesis and hastens the process of photosynthesis and carbon dioxide assimilation (Jasso-chaverria et al., 2005). Insufficient nitrogen reduces individual leaf area, leaf area index and total leaf area resulting in reduced surface light interception for photosynthesis (Cechin and Fumis, 2004).

Despite the important of fluted pumpkin in Nigeria diet, farmers are facing a lot of challenges concerning its production. Fluted pumpkin is cultivated in most part of eastern Nigeria and some part of northern Nigeria. Yield and quality of leaves relies by farmers are usually lower than what is being reported under experimental condition (Fashina et al.,2002). This is probably due to lack of important cultural techniques for maximum yield of these crops. This crop is cultivated without looking at the nutritional values. Research efforts are therefore requires to recommend the urea fertilizer rates that are better for maximizing good nutritional value of fluted pumpkin leaves in Unwana.

Materials and Methods

Experimental Site

The field experiment was conducted at the teaching, demonstration and research (TDR) farm of the Department of Horticulture and Landscape Technology, Akanu Ibiam Federal Polytechnic, Unwana-Afikpo South Local Government Area in the South eastern part of Nigeria during 2021 cropping season. Unwana is located on the latitude 06^0 05^1N and longitude 08^o 03^1E with an elevation of 300m above sea level (NIMET, 2014). The climatic and vegetation types are generally humid tropical rainforest with mean annual rainfall of about 3.500m and mean daily temperature of 32^0C to 21^0C (Njoku et al., 2006).

Experimental Design

The experimental field was cleared manually with cutlass.Soil sample was collected from five different strategic positions on the experimental site using soil auger at 10 to 15cm and bulked into composite sample. The soil sample was taken to National Root Crop Research Institute (NRCRI) Umudike, Abia State for physico-chemical properties (pH in water, pH $CaCl_2$, organic carbon, organic matter, total nitrogen, Available phosphorus, cations and Base saturation).The experiment was laid out in randomized complete block design (RCBD). The length and width of the experimental field was 15.5m x 19m respectively given a total land area of 294.5m^2 (0.02945ha). The treatment comprised of four rates of urea fertilizer (0, 40, 80 and 120kg/ha) and each treatment was replicated three times. Each block consists of four beds, given a total of twelve beds.

Land Preparation

The experimental field was cleared manually with cutlass and a raised bed of 5m x 3m were made with hoe on the already designed field. Fluted pumpkin seeds were extracted from healthy pods gotten from Eke market, Afikpo, Ebonyi State. The seeds were planted by direct sowing at a spacing of 1m x 1m. One seed was sown per hill at a depth of 1.5cm.

Fertilizer Application (Urea)

Urea fertilizer was applied at four rates of 0, 40, 80 and 120kg/ha. This was done fifth weeks after planting when the seedlings are tender with five leaves. Fertilizer was applied at a distance of 10cm radius in a ring around the plant and then covered with sufficient soil.

Crop Protections

Weeding was done manually which hoe when needed. Pest was controlled by the use of zap chemicals when the needed arose.

Harvesting

Harvesting of total herbage yield was carried out once when they are matured at 12^{th} week after planting (WAP). It was done manually by cutting of the vines with knife.

Preparation of Samples

The fluted pumpkin leaves as affected by four rates of urea fertilizer samples harvested at 12WAP were dried on electric oven at 70^0C for 48 hours. The leaves of each sample were ground to pass through 1mm sieve in order to provide enough surface area for thorough action of solvents and reagents to be used. The ground samples were preserved in cellophane bags and kept in desiccators.The proximate analyses for carbohydrate, crude protein, crude fiber, crude fat and moisture contents on the samples were determined at the Laboratory unit of National Root Crop Research Institute (Umudike), Abia State.

Data Collections/Measurement

Carbohydrate content on the prepared samples was determined by the method described by AOAC (2005). The crude proteins of the 4 samples were determined by the Micro Kjedahl method as described by Pearson (1976). Crude fiber and fat were also determined accordingly. Moisture content was determined by placing the harvested leaves in a brown envelop and dried in an electric oven at 70^0C till constant weight is obtained. The dry matter weight was subtracted from the original fresh weight.

Statistical Analysis

Nutritional composition data were subjected to analysis of variance for completely randomized design (CRD). The proximate compositions (carbohydrate, crude protein, crude fibre, fat and moisture contents) were compared using Fishers Least Significant Difference i.e. F-LSD as outlined by Obi (2012).

Results and Discussion

The results of chemical and physical properties of the experimental plots showed that the surface soils were slightly acidic with pH values of 5.80. This is in line with the report of Azu et al.(2017) who reported high acidity in most soils of Ebonyi State. According to Azu et al. (2018), the high concentration of oxides of iron and aluminum coupled with the presence of 1:2 clay minerals in the clay fraction of most hydromorphic soils of Ebonyi State is responsible for high exchangeable acidity and pH as observed in the study. The soils of the plots were low in organic carbon, 1.43% and nitrogen was 0.15%. The available P was 7.80mg/kg. The exchangeable cations (Cmol/kg), Ca^{2+}, Mg^{2+}, K^{+} and Na^{+} were 3.00, 1.00, 0.32 and 0.02, respectively (Table 1). Total nitrogen and available phosphorus were low and below the critical level of 0.15% and 12mg/kg as proposed by Osodeke and Ubah (2005). Generally, the basic cations, except Calcium were low which might be responsible for the high pH. The exchangeable acidity was high (2.82cmol/kg), owing to the high concentration of sexquoxide in the soil. The effective cation exchange capacity (ECEC) and base saturation were moderately high (7.16cmol/kg and 60.11%, respectively).

The potential of a particular food is determined primarily by its nutrient composition. Leafy vegetables are known to add taste and flavor, as well as substantial amounts of crude protein, crude fibre, minerals and vitamins to the diet (Nnamani et al.,2009). The results of the analysis of variance of percentage carbohydrate, crude protein, crude fat, crude fibre and moisture contents of fluted pumpkin leaves as affected by four rates of urea fertilizer are presented in Table 2. The nutritional composition showed very highly significant effects in percentage carbohydrate, crude protein and crude fiber except percent crude fat and moisture content (see Table 2).

Percentage carbohydrate content of fluted pumpkin as influenced by urea fertilizer showed significant differences P = 0.01 (Table 2). 80kgN/ha produced the highest carbohydrate of 4.96% and they differed from the other urea fertilizer rates (Table 3). However, 0kgN/ha produced the least carbohydrate content of 3.28%. The carbohydrate values obtained for urea fertilizer, 80kgN/ha (4.96%) were comparable with the value of 6.39 ± 2.66% reported by Loukou et al. (2007) for *Arachis hypogaea.* 80kgN/ha gave the highest crude protein content (12.01%) whereas, 0kgN/ha had the least protein content (8.53%) and they differed significantly from each other. The protein content produced at 80kgN/ha differed significantly from other percentage protein content recorded on other urea fertilizer rates used (Table 3). This crude protein values differed favourably with the crude protein values reported for yam (7.31% and 9.67%), *Zanthoxylum zanthoxyloides* (Hercules Club,'Nka') (8.74%) (Nnamani et al.,2009). They also stated that any plant foods that provide about 12% of their calorific value from protein are considered good source of protein. All the urea fertilizer rates, therefore meet this requirement with crude protein contents mentioned above.

The analysis of variance showed non-significant (P = 0.05) differences on percentage crude fat content as affected by urea fertilizer rates (Table 2). Although, 120kgN/ha gave the highest percentage crude fat content of 2.62% whereas control plots (0kgN/ha) produced the least crude fat content of 1.84% (Table 3).There was highly significant (P = 0.01) effect in crude fiber content of fluted pumpkin under four rates of urea fertilizer investigated (Table 2). The 80kgN/ha, produced the highest percentage crude fiber content (5.38%) which differed from the other urea fertilizer rates studied. However, 0kgN/ha gave the least crude fiber content of 3.79% (Table 3).The highest crude fibre contents produced at 80kgN/ha across the Urea rates used, were high when compared with soybean (0.2%), (Saurez *et al.,* 1999), *Talinum triangulare* (6.20%), *Piper guineensis* (6.40%), bitter leaves (*Vernonia amygdalina*), 6.5% and *Corchorus olitorius* (7.0%), (Oboh et al., 2003). Crude fiber is the part of food that is not digested by human beings but the normal functioning of the intestinal tract depends upon the presence of adequate fiber. This increases stool bulk and decreases the time that waste materials spend in the gastrointestinal tract. Fiber helps in the maintenance of human health and has been known to reduce cholesterol level in the body (Lajide et al.,2008).

Urea fertilizer at the rates of 120kg/ha, had high moisture contents of 75.02% and this could imply short shelf life. High amount of moisture content on leafy vegetables makes them vulnerable to microbial attack, hence, spoilage. The moisture content of any food is an index of its water activity and is used as a measure of stability and the susceptibility to microbial contamination (Scott, 1980). This high moisture content could also means that dehydration would increase the relative concentration of other food nutrient and therefore improve the shelf-life and preservation of the fruits. The relative high moisture content observed in this study is in line with the report by Umoh (1998). He reported that high moisture content is typical for fresh fruits at maturity. Thomas and Oyediran (2008) had earlier reported 82.8% moisture content for *C. esculenta* which is in the same range of moisture content obtained in the study.

Conclusion

However, the influenced of urea fertilizer at four rates on the proximate composition showed that the plots treated with 80kg/ha, produced the highest proximate composition on carbohydrate, crude protein and crude fiber while 120kgN/ha gave the best in crude fat and moisture content of fluted pumpkin leaves. The plots with no urea fertilizer consistently gave the lowest values on all the nutrient parameters measured. However, we recommend 80kg/ha of urea fertilizer for better improvement on the nutritional composition of fluted pumpkin leave in Unwana-Afikpo. More research, however, is needed, especially in the areas of the proximate composition of fluted pumpkin vines or seeds with different urea fertilizer rates.

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Table 1. Pre-Planting Soil Chemical and Physical Properties of the Experimental Plots

Constituents	Quantities
pH (H_2O)	5.28
pH ($CaCl_2$)	4.10
Organic Carbon (%)	1.43
Organic Matter (%)	2.49
Total Nitrogen (%)	0.15
Available Phosphorus (mg/kg)	7.80
Ca^{2+} (Cmol/kg)	3.00
K^{+} (Cmol/kg)	0.32
Mg^{2+} (Cmol/kg)	1.00
Na^{+} (Cmol/kg)	0.02
ECEC (Cmol/kg)	7.16
TEA (Cmol/kg)	2.82
BS (%)	60.11
Sand (%)	39.67
Silt (%)	16.35
Clay (%)	43.98
Texture	Clayey Loam

Table 2. Form of Analysis of Variance showing Sources of Variation, Degrees of Freedom and Mean Squares for Proximate Composition of Fluted Pumpkin Leaves as affected by Four Different Rates of Urea Fertilizer (kg/ha)

		Mean Squares				
Sources of Variation	**Degrees of Freedom**	**Carbohydrate**	**Crude Protein**	**Crude Fat**	**Crude Fiber**	**Moisture**
Block	1	0.000112	1.12500	0.09031	0.01051	1.8336
Urea	3	0.996046**	4.48208**	0.45015n.s	1.17965**	1.4966n.s
Error	3	0.001779	0.07210	0.07688	0.01265	0.3356
Total	7					

**** Very Highly Significant Effect (P = 0.01)**
n.s Non Significant Effect (P<0.05)

Table 3. Proximate Composition of Fluted Pumpkin Leaves as affected by Four Different Rates of Urea Fertilizer (kg/ha)

	Percentage (%)				
Urea Fertilizer Rates (kg/ha)	**Carbohydrate**	**Crude Protein**	**Crude Fat**	**Crude Fiber**	**Moisture**
0	3.275	8.525	1.535	3.790	72.95
40	3.880	9.620	2.230	3.950	73.65
80	4.960	12.010	2.445	5.380	74.10
120	4.260	10.755	2.615	4.935	75.02
$LSD_{0.05}$	0.1342	0.8545	n.s.	0.3579	n.s.

n.s Non Significant Effect (P<0.05)

EFFECT OF ORGANIC MANURE ON THE GROWTH AND YIELD OF AMARANTH (*Amaranthus cruentus*)

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Abstract

Low soil fertility status is a major constraint to sustainable crop production in the humid tropics, thus necessitating the need for regular external fertilizer input. The effect of organic manure on the growth and yield of Amaranth (Amaranathus cruentus) was evaluated. The experiment was conducted at the Teaching, Demonstration and Research (TDR) farm of the Department of Horticulture and Landscape Technology, Akanu Ibiam Federal Polytechnic, Unwana, during 2020 cropping season and was laid out in randomized completed block design (RCBD). The treatment comprised of four different organic manures (cow, goat, pig and poultry dungs) and a control plot (plot without organic manure). Each treatment was replicated three times and the parameters measured were: Plant height, number of leaves, number of branches, stem girth, leaf area, fresh weight of leaves and leaf yield. The results showed that poultry manure significantly increased the plant height, number of leaves and branches, fresh weight of leaves and leaf yield. Application of poultry manure was found to be the best organic manure for maximizing number of leaves and branches with approximately 81 leaves and 11 branches, respectively and leaf yield of 133.20tons/ha. Control plots (non-organic manure plots) consistently gave the least values on all the parameters measured. However, it is recommended that farmers at Unwana who intend to embark on massive Amaranth should apply poultry manure for maximum production of its leaves.

Keywords: Amaranth, Leaf yield, Organic Manure, Poultry Dung

Introduction

Amaranth (*Amaranthus cruentus*) originated from America and is one of the oldest food crops in the World, with an evidence of its cultivation reaching back as far as 6700 BC. Amaranth is scientifically classified as a weed (Akobundu, 1984). It is a tall annual herb with clusters of dark pink flowers and it can grow up to 2m in height. It is believed to have originated from *Amaranthus hybridus,* with which it shares many morphological features. The plant is usually green in colour. It is a highly perishable vegetable (Rice*,* 1987).

Amaranth seeds need soil temperature between 18^{o}C and 25^{o}C to germinate and air temperature above 25^{o}C for optimum growth. The growth ceases at the temperature below 18^{o}C. Lower temperature and shorter days will induce flowering with a subsequent reduction in leaf yield. The crops cannot withstand water logging as it has a relatively low capacity for water consumption. It is a crop that is adapted to a variety of soil types, including marginal soils, but does best on fertile, well-drained soils and deeper soils. Loose and friable soils with high organic matter content are ideal for an early and heavy yield of Amaranth (Rice*,* 1987). The growth of Amaranth is adversely affected by a soil pH of 4.7.

It is an important vegetable in human diets which serve as source of nutrients such as vitamin, minerals, sugar, water, protein and fiber. These nutrients are needed for healthy body, growth and sustenance. The young leaves and stems are boiled as greens and are use in soup making (Adeyemi et al., 1987). The nutrient values of Amaranthper 100% edible portion of the leaves are 85ml water, 48 calories, 5g protein, 0.7g fat, 5g carbohydrates, 1.5g fiber, 250mg calcium, 4mgIron, 1800mg β-carotene equivalent, 0.1mg thiamine, 0.3mg riboflavin, 1.5mg niacin and 100mg ascorbic acid (Trinall, 1975). Vegetable production has becomes a good source of employment for young school leaves (DFRRI, 1990).

Amaranth responds well to good soil fertility and organic manure application. Jusst like other tropical crops, the major limitation in the large production of Amaranth is the declining soil fertility (Azu et al., 2017). Profitable crop production in Nigeria cannot be possible without external fertility input and in line with that, different chemical fertilizers have been most times used to improve the soil fertility and plant nutrition (Awodum, 2007). In the quest to improve crop mineral nutrition, persistence and aggressive mineral fertilizer use have over the year been adopted. Recent findings have presented the negative effect of over use of chemical fertilizer such as soil acidity, loss of organic matter etc in cropping system (Awodum, 2007).

Consequent of these, emphasis has been now been shifted to organic fertilizer use to improve soil physical, chemical and biological condition, thereby giving the soil a long lasting fertility effect. Organic manure has the potential to improve nutrition, boost food security and sustainable soil nutrition. Several reports on the soil fertility effects of poultry manure have been reported (Azu et al., 2018, Azu et al., 2017), but effects of these organic manure has not been investigated in the acid utisols of south eastern Nigeria. Therefore**,** the objective of this study was to determine the effect of organic manure on the growth and yield of Amaranth (*Amaranthus cruentus*) in Unwana.

Materials and Methods

Experimental Site

The field experiment was conducted at the teaching, demonstration and research (TDR) farm of the Department of Horticulture and Landscape Technology, Akanu Ibiam Federal Polytechnic, Unwana in the Southeastern part of Nigeria during 2020 cropping season. Unwana is located on the latitude 06^{0} 05^{l}N and longitude 08^{o} 03^{1}E with an elevation of 300m above sea level (NIMET, 2014). The climatic and vegetation types are generally humid tropical rainforest with mean annual rainfall of about 3.500m and mean daily temperature of 32^{0}C to 21^{0}C (Njoku et al., 2006).

Experimental Plot and Design

The experimental field was cleared manually with cutlass. Soil sample was collected from five different strategic positions on the experimental site using soil auger at 10 to 15cm and bulked into composite sample. The soil sample was taken to National Root Crop Research Institute (NRCRI) Umudike, Abia State along side with four different organic manure (cow, goat, pig and poultry dung) samples for analysis of physico-chemical properties of them. The experiment was laid out in randomized complete block design (RCBD). The length and width of the experimental field was 16.5m x 10m respectively given a total land area of $165m^2$. The treatment comprised of four different organic manure with control plots (plots without organic manure) and each treatment was replicated three times. Each block consists of five beds, given a total of fifteen beds.

Land Preparation and Planting

The experimental field was cleared manually with cutlass and a raised bed of 2m x 2m were made with hoe on the already designed field. Amaranth seedlings were obtained from NIHORT, Oyo State at 3 (three) weeks after germination (WAG). The seedlings were transplanted in eight rows and four columns at a spacing of 25cm x 50cm.One seedling were transplanted per hill.

Organic Manure Application

Organic manure (poultry, pig, goat and cow dung) were applied at the rate of 5kg per bed, two weeks before transplanting and it was done manually by incorporating the different organic manure into the soil based on the bed allotted to them.

Crop Protections

Weeding was done manually with hoe when needed. Pest was controlled by the use of zap chemicals after transplanting especially when the needed arose.

Harvesting

Harvesting of Amaranth commenced at 6^{th}weeks after transplanting (WAT) when the foliage changed colour to pale green.

Data Collections/Measurement

The following data were collected at 6^{th} week after transplanting (WAT)**;** Plant Height (cm): measured by taken the distance from the soil surface to the tip of the plant. Number of leaves was determined by counting. Number of branches was determined by counting the number of off-shoots from the main branch. Leaf Areas (cm^2) taken by measuring the length and width of five leaves. Stem Girth (cm) taken with vernier caliper at the base 5cm above the soil surface. Fresh Leaves (kg) per bed were weighed at harvest and was recorded in kilogram (kg). Leaf Yield (tons/ha) was gotten from converting weight of leaves to tons/ha.

Statistical Analysis

Data collected were subjected to analysis of variance (ANOVA) and separation of treatment means was by the use LSD at 5% level of probability (Obi, 2001).

Results

Physico-Chemical Properties of the Soil and Organic Manure

The results of the pre-cropping soil and organic manure are presented in Table 1. The soil was sandy loam with low organic matter content and pH (H_2O) around the high acidic range. The nitrogen, phosphorus, potassium and other cations are very low in the soil used in this study. Poultry dung has high N (4.50%). Organic carbon was high in poultry when compared to other organic manure used and also in terms of percentage organic nitrogen.

Effects of Organic Manure on the growth and yield of Amaranth

Plant Height (cm)

The result showed that organic manure had significant effect on plant height at P = 0.01. Plant height obtained at poultry manure differed significantly from plant height of Amaranth recorded at cow dung,goat dung and control plots which were 30.90cm, 31.00cm and 20.70cm, respectively.The plant height recorded at pig dung (40.60cm) was statistically similar with plant height recorded at poultry dung. Although, the control plotsproduced the shortest plant of 20.70cm (Table 2).

Number of Leaves

Organic manure had significant effect on the number of leaves produced (Table 2). The highest number of leaves was obtained at poultry dung followed by pig dung having approximately 81 and 56 leaves respectively, which differed significantly from other organic manure used in the experiment.

Number of Branches

The effect of organic manure on the number of branches produced was highly significant (Table 2). Poultry manure produced the most profusely branched plant with approximately 11 branches, while the least number of branches was recorded at the control treatment which had 4 branches and they differed significantly from each other. Number of branches produced at poultry dung (11.10) was statistically similar with number of branches produced from Cow dung (8.11) and Pig dung (10.22) respectively but differed significantly from goat dung (5.67).

Stem Girth (cm)

In Table 2, the effect of organic manure was non-significant on the stem girth of Amaranth produced. Stem girth was bigger on plants were poultry dung was applied (1.18 cm) and least at control plotand goat dung with 0.91cm stem girth, respectively.

Leaf Area (cm^2)

Leaf area of Amaranth was not significantly affected by organic manure application. The highest leaf area was obtained at the application of poultry dung (31.20cm^2), followed by pig dung, cow dung, goat dung with 27.70cm^2, 22.70cm^2 and 20.90cm^2, respectively and least was recorded on control treatment.

Fresh Weight of Leaves (Kg)

Organic manure had significant effect on the fresh weight of leaves of Amaranth at P=0.05 (Table 2). The heaviest fresh leaves of 3.25kg were obtained at poultry dung which differed significantly from other organic manure used in the experiment. The fresh weight of leaves was least at the control treatment which was 1.00kg

Leaf Yield (Ton/ha)

The application of organic manure had highly significant effects on the leaf yield of Amaranth at P = 0.01 (Table 2). The highest leaf yield of 133.20t/ha was recorded at the plots with poultry dung but differed significantly from other organic manure used in the experiment except for pig dung (101.40tons/ha) both of which were statistically similar. The lowest leaf yield was at control treatment with 51.80tons/ha. The yield was highest at poultry dung (133.20tons/ha), followed by pig dung (101.40tons/ha), goat dung (77.60tons/ha) cow dung (77.20tons/ha) and control treatment (51.80tons/ha).

Discussion

Most of the nutrients in the soil used for the experiment were below the critical level making it necessary for the application of soil amendment inform of organic manure. The result of this field trail showed that organic manure application had significant effect on plant height, number of leaves, number of branches, fresh weight of leaves and leaf yield produced. The significant response of Amaranth to poultry manure application in terms of plant height, number of leaves and number of branches may be attributed to high nutrient absorption by the plant. This may be as a result of the higher availability of nitrogen in poultry manure which encourages higher vegetative growth (Ndor et al., 2010)

The application of poultry manure gave the highest yield of Amaranth. This is in agreement with the report of Husseni (2006) who revealed that poultry manure is superior t2o other source of organic manure. The fresh weight of leaves produced by poultry manure treated plots showed significant difference from other organic manure treatment used. Thus, greater number of leaves, fresh leaf weight and total leaf yield recorded from the poultry manure plots could be attributed to the ability of the manure source to mineralize. Madukwe et al. (2008) noted that organic manure especially poultry manure resulted in increase number of nodules and higher yield in cowpea, and that poultry manure was efficient in the amendment of degraded soil. Control treatment (non-organic manure plots) consistently gave the lowest values in all the parameters measured.

Conclusion

In this experiment, poultry manure had a positive effect on the growth and yield of Amaranth. Poultry dung as one of the organic manure used proved to be the best organic manure for maximizing higher yield of Amaranth per hectare. From the observation in the field experiment, we recommend that farmers in Unwana who tends to embark on massive production of Amaranth should use poultry dung in raising the crop. Alternatively; pig dung is also good for maximizing its yield.

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Table 1. Physico Chemical Characteristics of Different Organic Manures and Soil Samples beforeTransplanting of Amaranth Seedlings.

Elements	Poultry	Pig	Cow	Goat	Soil
pH in H_2O	8.12	7.21	6.40	6.60	6.00
Mg (Cmo1/kg)	0.42	2.54	0.87	0.42	0.52
Na (Cmo1/kg)	0.35	9.30	0.30	0.26	0.02
Ca (Cmo1/kg)	5.20	3.04	1.10	0.63	2.20
K (Cmo1/kg)	6.25	2.62	1.10	0.17	0.01
P (Cmol/kg)	0.31	1.46	4.50	4.80	3.62
% Organic Carbon	46.80	25.91	16.85	16.90	1.26
% Organic Nitrogen	4.50	2.80	2.10	2.40	0.02
Sand	0.00	0.00	0.00	0.00	89.52
Silt	0.00	0.00	0.00	0.00	7.00
Clay	0.00	0.00	0.00	0.00	3.48
Textual class	0.00	0.00	0.00	0.00	Sandy loam

Lab Result (2020)

Table 2. Effect of Organic Manure on the Growth and Yield of Amaranth (*Amaranthus cruentus*) in Unwana

Different Organic Manure	Plant Height (cm)	Number of Leaves	Number of Branches	Stem Girth (cm)	Leaf Area (cm^2)	Fresh Weight of Leaves (kg)	Leaf Yield (Ton/ha)
Control	20.70^b	9.50^e	3.78^c	0.91^a	20.30^a	1.00^b	51.80^c
Cow Dung	30.90^b	33.50^c	8.11^a	0.98^a	22.70^a	1.10^b	77.20^b
Goat Dung	31.00^b	24.30^d	5.67^b	0.91^a	20.90^a	1.02^b	77.60^b
Pig Dung	40.60^a	56.20^b	10.22^a	0.93^a	27.70^a	0.88^b	101.40^a
Poultry Dung	53.30^a	81.30^a	11.10^a	1.18^a	31.20^a	3.25^a	133.20^a
$LSD_{0.05}$	13.82	22.59	4.04	N.S	N.S	1.51	34.45

Means in the same column having the same letter (s) are not significantly difference at (P=0.05); LSD = Least Significant Difference and N.S = Non Significant from the preliminary table