Influence of Different Organic Manures on Agronomic Performances of *Celosia argentea* (L.) in Humid Rainforest South western Nigeria

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Abstract: Farmers in rural areas are vulnerable to hunger and poverty because of the poor fertility state of their soils. The use of organic manures could improve agricultural productivity for these farmers. The current study was carried out to evaluate the performance of *Celosia argentea* planted with 25t ha^{-1} poultry manure (PM), cow dung (CD) and compost in randomized complete block design replicated three times. There was also control plot with no addition of organic manure. The results from the study shows that plots amended with 25t ha^{-1} poultry manure significantly ($P< 0.05$) influenced the agronomic performance of *C. argentea* in respect to plant height, number of leaves and stem girth at 2 and 4 weeks after transplanting (WAT); which relatively translate to higher yield (7.6kg/plot) compared to other treatments. Based on the findings from this study, it is recommended that soil amended with 25t ha^{-1} PM is good for *C. argentea* production due to its high nitrogen content which influenced the crop agronomic performances and ultimately the yield. It was also noted that CD can serve as a better substitute for poultry manure.

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Introduction

Higher crop yields are desirable due to the increasing pressure for non-agricultural use of the land that has drastically reduced the fallow periods. There is therefore, an important need to increase the productivity of the land through the application of organic manure and/or inorganic fertilizer. The depletion of soil nutrients due to continuous cropping reduces the soil organic matter, cause significant acidification and yield reduction (Batiano and Makwunye, 1991; Anonymous, 1995; Ajilore, 2008). There is therefore need for adequate fertilization or manuring in order to sustain soil productivity for optimum growth and yield of planted crops to ensure food security for the ever increasing growing population.

Celosia argentea an edible species of the genus *Celosia* of the Amaranthaceae family is widely grown in gardens and other parts of West Africa. This leafy vegetable is an essential component of people's diet in Nigeria and other parts of West Africa. The leaves and young shoots are used in soups and stews. The leaves contain high levels of calcium, phosphorus and iron. This plant is an important source of proteins, calories, vitamins and minerals (Akinyemi and Tijani-Eniola, 1997) that enrich the diet the people of West Africa. The crop is predominantly produced in Nigeria by resource-poor farmers and compound gardens where it is intercropped with arable starchy staples to produce enough food to satisfy their dietary and cash requirements (Akinyemi and Tijani-Eniola, 1997), and to minimize the risk of crop failure. Although, there is a wealth of information on the dietary importance of *C. argentea*, a leafy vegetable whichis extensively grown in West Africa (Tindall, 1983; Akanbi, *et al* 2006), little is known about its nutritional requirements generally. This is because in West Africa'sfarming system, leafy vegetables are regarded as backyardcrops. However, this idea is changing, with thedevelopment of private and government vegetable gardens on a large scale. This, coupled with the scarcity and high cost of obtaining mineral fertilizer, calls for search for alternatives (Akanbi et al., 2006), and thus necessitate this research. Specifically, this work focuses on the assessment of effect of organic amendment on the growth and performance of *C. argentea.*

Materials and methods

Experimental site

The experiment was carried out at the Teaching, Research and Commercial Farms of Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria (7^0 11' 43" N 5^0 33' 57" E). The site was previously cultivated with yam, melon and cassava and later allowed to fallow

for two years before it was used for the trial. The dominant fallow plant species on the land was guinea grass (*Panicum maximum*) and *Euphobia heterophylla*. Prior to land preparation, pre-planting soil samples was randomly collected using soil auger per replicate within the depth of 0–20 cm at the start and end of the experiment. Soil samples were air-dried, ground and sieved to pass through a 2-mm sieve. The following chemical analyses were done on the soil samples and the manure, using standard laboratory methods: soil *p*H (soil: water ratio of 1:25); organic carbon; total nitrogen, available P (using Bray-1 method), exchangeable basic cations; exchangeable acidity and effective cation exchange capacity (by summation method) (Okalebo, 2002). Particle size analysis was determined on the soil using Bouyoucos method (Bouyoucos, 1962).

Sample collection

Poultry manure and cow dung used for the study was obtained from the livestock unit, Teaching and Research Farms, Rufus Giwa Polytechnic Owo, Ondo State Nigeria. While compost was obtained from the Sunshine Waste-to-Wealth company, Akure, Nigeria. The samples were shade dried, pulverized to pass through 2mm sieve before analysis and the result is shown in table 1.

Seeds of *C. argentea* L. var. TLV8 were purchased from National Horticultural Research Institute (NIHORT), Ibadan, Nigeria.

***Land Preparation and Crop Management*:** The land was cleared using slash method, the debris was packed and beds constructed to a height of about 30cm (to ensure that the profile stay in position), reduce compaction and increase water infiltration. Prior to planting, each treatment was applied to each plot and worked into the soil properly to facilitate even distribution of the applied materials. The experimental site was 275m^2 and each bed was 1m × 5m^2 with a discard of 1m on both sides and 1m in between the beds; using Randomized Complete Block Design (RCBD). Seeds of *C. argentea* L. var. TLV8 were sown in wooden trays and watered well. Three weeks later, the resulting seedlings were transplanted at 25cm x 25cm and watered to ensure establishment. Cow dung, compost and poultry manure was applied to each plot at 25t ha^{-1}. The treatment 0 t ha^{-1} where no organic manure was applied was set up as a control experiment. The field was manually rouged as required to prevent weed competition. Watering was done every day for the first three weeks and continued every other day till harvest. Lambda cylothrin EC 25%, 0.16m/l was sprayed bi-weekly to control insect pest infestation on the leaves. The *C. argentea* varietal "TLV 8" cultivated was obtained from National Horticultural Research Institute (NIHORT) Ibadan,

Data collection and analysis

Five plants were randomly sampled per plot to determine plant height, stem girth, number of leaves at 2, and 4 weeks after transplanting (WAT). Meter ruler was used for the measuring of the *Celosia* plant height from base to the tip of the main shoots while the number of leaves were counted and recorded. Stem girth was measured using vernier caliper. Harvesting was done by cutting the plant at 10cm above soil surface was done at 6 WAT. The fresh shoot and leaves were weighed using digital weigh balance. Data collected were subjected to Analysis of Variance (ANOVA) using SAS 2008 software package and treatment means was separated using Least Significant Difference (LSD) at 5% probability level.

Results

The fertility status of the soil used for the study is very low in major nutrient elements (Aduayi *et al* 2002). The soil is sandy loam, low in organic carbon, nitrogen and phosphorus (Table 2). This implies that cropping the soil without fertilizer use will not be economical.

Table 2: Physiochemical properties of experimental soil

Composition	value	Composition	Value
pH (H_2O)	4.92		pH
(KCl)	4.32		
Total Nitrogen (%)	0.093		Organic
carbon (%)	9.01		
Available P.	29.23		Mg
	5.08		
K	1.16		Na
	0.91		
Fe	137.42		Mn
	93.24		
Cu	20.41		Zn
	55.74		
Soil physical analysis			
Sand	71%	Clay	8.8%
Silt	20.1%		
Textural class			Sandy
loam			

Celosia growth parameters at 2 weeks after transplanting (2 WAT) is presented in table 3. The table shows that *Celosia* treated with poultry manure (PM) had the tallest plants (17.92 cm) and highest number of leaves (18.16), this closely followed by cow dung (CD) (15.08 plant height and 16.50 number of leaves. The lowest value was recorded from the control plot. The organic manure treatments were

significantly different (P < 0.05) compared to control treatment.

Table 4 shows plant height, number of leaves, stem girth at 4 WAT and yield at harvest respectively. From the data obtained it shows that PM amended soil had the tallest plant (56.02 cm), followed by cow dung (54.40 cm) which is not significantly different (P<0.5) when compared and the shortest plant in control treatment (40.40 cm) and was significantly different (P < 0.05) when compared with both PM and CD. PM had the highest number of leaves (47.50); followed by CD (41.20), compost (38.40) and the lowest number of leaves obtained in control plots (35.00) at 4 WAT. Statistically analysis revealed that there is non-significant difference (P<0.05) between PM and CD but all the organic manure applied were significantly different (P<0.05) compared to control.

terms of stem girth at 4 WAP (table 4), the result shows that all the treatments revealed close data, with PM having the highest value (5.00cm^3), followed by CD (4.40cm^3), compost (3.60cm^3) and lowest girth recorded in control plot (3. 32cm^3). All the organic manure applied was significantly different (P< 0.05) compared to control plots.

Yield obtained from the study followed the same trend as obtained for stem girth development, with PM recorded the highest yield (1.50kg), closely followed by CD (1.00kg) and the lowest yield obtained from control plots (0.50kg). From the result it was observed that PM and CD were not significantly different when compared, but all the manures applied were significantly different (P< 0.05) compared to control treatment.

The use of organic amendments produced significant effect on the performance of *Celosia* when compared with the control plants. All the growth parameters taken were positively improved by the organic amendments. This might be due to the low nutrient status of the experimental plot. Adequate nutrients availability had been indicated to improve crop growth and yield parameters. The result of the poultry manure revealed high content of nitrogen and other nutrients which indicates that high nutrient content is required for a successful growth and yield of *Celosia*. This confirm the findings of Adewale *et al* (2011), that increase in plant growth and yield as a result of application of organic manure is expected in that manure contained and released considerable amount N and Mg for plant use during the process of mineralization. These are essential for formation of chlorophyll for photosynthesis in plants and the variation in growth parameters due to nutrient sources was considered to be due to variation in the availability of major nutrients. This also is in consonance with the findings of Frank (2000) that Nitrogen enhances physiological activities in crops thereby improving the synthesis of photoassimilates. The ability of poultry manure to increase the performance of *Celosia* could also be attributable to the fact that organic manures improve both physical and chemical soil properties (Yahaya, 2008).

Generally, from the study there was an increase in the performance of the crop on the parameters measured and overall yield. This implies that *celosia* responds well to organic fertilizer as the application of PM and CD influences its growth and yield. This implies that the addition of poultry manure in *Celosia* production is a means of improving the yield in Nigeria and thus making its cultivation productive and sustainable. Therefore, the cultivation of *Celosia* in South West Nigeria could be a profitable enterprise as against popular belief if emphasis is placed on the use of fertilizers from organic sources.

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Table 1: Laboratory analysis of major nutrients present in the manure used

Manure type	Nitrogen (g/kg)	Phosphorus (g/kg)	Potassium (g/kg)
Poultry manure	60.09	23.05	45.95
Cow dung	45.07	21.90	29.87
Compost	38.54	20.06	22.87

Table 2: Physiochemical properties of experimental soil

Composition	value	Composition		Value
pH (H_2O)	4.92	pH (KCl)		4.32
Total Nitrogen (%)	0.093	Organic carbon (%)		9.01
Available P.	29.23	Mg		5.08
K	1.16	Na		0.91
Fe	137.42	Mn		93.24
Cu	20.41	Zn		55.74
Soil physical analysis				
Sand	71%	Clay 8.8%	Silt	20.1%
Textural class		Sandy loam		

Table 3: Growth parameters at 2 Weeks after Transplanting

Treatments	plant height	no of leaves
Poultry manure	17.92	18.16
Cow dung	15.08	16.50
Compost	14.08	15.20
Control	12.06	12.10
LSD (5%)	2.96	2.49
SE±	1.12	0.81

Table 4: Growth parameters at 4 Weeks after Transplanting and yield at harvest

Treatments	plant height (cm)	no of leaves	stem girth (cm^3)	yield (kg)
Poultry manure	56.02	47.50	5.00	1.50
Cow dung	54.50	41.20	4.40	1.00
Compost	47.20	38.40	3.60	0.70
Control	40.40	35.0	3.20	0.50
LSD (5%)	6.56	3.25	0.81	0.69
SE±	2.13	1.05	0.26	0.23

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