



INFLUENCE OF POPULATION DENSITY AND POULTRY MANURE RATES ON GROWTH AND YIELD OF CELOSIA (*Celosia argentea*)

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Abstract

Competitive survival of crops in terms of light, fertilizers and even moisture often lead to unproductivity and disease outbreak as a result of inadequate spacing for crops. However, adopting the optimal spacing and appropriate soil amendments has increased the level of productivity of vegetables in the tropics. Hence, this research work focused on deriving the adequate population density for growing Celosia with the application of poultry manure. It was conducted at horticultural research site of Federal University of Agriculture Abeokuta (7°, 25'N 3°25'E, in a derived savanna at a height of 100 meters above sea level. The experiment was a 2 factorial consisting of planting population at four levels (5, 10, 15 and 20 plants /m) and Poultry manure rate at two levels (0 and 5ton/ha). Four replications of the experiment were set up using a Randomized Complete Block Design (RCBD). Seeds of Celosia were sown by using drilling method and seedlings were reduced after seed germination to population of 5 plants /1.5 x 2 m, 10 plants /1.5 x 2 m, 15 plants /1.5 x 2 m, and 20 plants /1.5 x 2 m. Celosia planted at 15 plants per plot had the tallest plants, more leaves and wider leaf area in the first planting but had more leaves than other population in the second planting, though they were not significantly different. 10 tons per hectare Poultry manure resulted in higher plants, more leaves, and a wider leaf area in both plantings; nevertheless, the only notable variations were in the height of the plants in the second experiment and the quantity of leaves in the first trial.

Keyword: *Celosia argentea*, Population density, Poultry manure, Yield

Introduction

Celosia argentea belongs to the family Amaranthaceae and it's a vegetable consumed mainly for its delicious leaves otherwise known as Lagos spinach, cockscomb and quail grass (Ilodibia *et al.*, 2016). The vegetable is rich in vitamins A and C, iron, calcium and fibre. It is high in antioxidant properties, ascorbic acid, Calcium and contains 4.7% protein. Traditionally, the leaves can be applied on the skin for the reduction of swelling and wound treatment (Grubben *et al.*, 2004). Celosia can be considered by small scale farmers as a means of providing an additional income. The technique of spacing is an important way of minimizing competitive threat that usually occur as a result of high population density. According to Orluchukwu *et al.*, (2014),

celosia planted at low population density increased significantly compared to the ones planted high population density. Poultry manure is a proven soil amendment for improving the health condition of the soil to increase productivity in farming. It significantly increased the fresh leaf weight of celosia in two growing seasons (wet and dry season) at 4 and 6 weeks after transplanting compared to the untreated plants. Application of 5tonnes/ha gave the highest root weights than 0 tonnes/ha at 4 weeks after transplanting but emerged similarly at week 6 after transplanting. The untreated plants had lower root weights at both weeks (4 and 6) after transplanting (Makinde *et al.*, 2016).

The purpose of the study was to determine how celosia growth and yield were affected



by varying population densities and rates of poultry manure treatment. It was aimed at ascertaining the optimum poultry manure and the adequate population density of celosia.

MATERIALS AND METHODS

Experimental Site: The study was carried out at the Federal University of Agriculture Abeokuta horticultural research site (FUNAAB) (7°, 25'N 3°25'E, 100 m above sea level) in a derived savanna.

Description of Test Crops: Healthy seeds of *Celosia argentea* were procured in Abeokuta.

Experimental Design: The experiment was a 2 factorial consisting of planting population at four levels (5, 10, 15 and 20 plants /m) and Poultry manure rates at two levels (0 and 5ton/ha). Four replications and a Randomized Complete Block Design (RCBD) were used to set up the experiment.

Experimental procedure

Seeds of *Celosia* were planted by using drilling method and seedlings were reduced via thinning exercise after seed germination to populations of 5 plants /1.5 x 2 m, 10 plants /1.5 x 2 m, 15 plants /1.5 x 2 m, and 20 plants /1.5 x 2 m. Poultry manure at the rate of 0 (control) and 5 tons/ha (poultry manure) was applied to the field two weeks before sowing for mineralization.

Data Collection: The following data will be collected on the following parameters:

- **Number of branches:** Each plant's branches were counted and noted.
- **Stem girth:** This was determined with the use of Vernier calliper at 5cm above soil mark
- **Shoot fresh weight:** This was measured after harvesting of the plant samples before oven drying.
- **Number of leaves:** Every leaf on the sample plants was tallied, noted, and estimated for each plant.

- **Average leaf area (cm²):** with formula of $7.49x - 35.66$ (Makinde et.al, 2016)
- **Shoot dry weight:** This was measured after plant samples were harvested and dried in an oven separately at a constant temperature of 70°C.
- **Plant height:** The sample plants were measured from ground level to the main branch apex of the plant to determine the plant height.

Nutrient content analysis: Fresh harvested plant samples were collected at the end of the experiment and oven dried until a constant weight is obtained to obtain the dry matter yield. The leaf samples will be analysed for % ash, %lipid, %crude protein, N, K and P according to the methods described by AOAC

Statistical Analysis: Using Genstat Discovery, the acquired data was subjected to Analysis of Variance (ANOVA), and the mean was separated at the 5% probability level using Least Significant Difference.

RESULTS

Pre-cropping Soil Fertility Status: The soil used for the experiment was sandy loam soil and neutral (pH 6.84). The Nitrogen, Phosphorus and Potassium content were 0.71 %, 10.18 % and 0.38 cmol respectively. The organic carbon content was 0.09 % while the base saturation was 99.35 % (Table 1).

Nutrient Status of poultry manure: The PM utilized for this study was strongly alkaline the N content was 0.40 % while the P and K were 116.18 and 181.37 (mg/100g) respectively. The poultry manure was high in organic matter content of 27.32%.

Post cropping analysis: Upon completion of the experiment, all the soil from plots that received application of 5 ton/ha PM irrespective of the population density were



neutral sandy loam soil and neutral and the N content ranging from 0.18-0.21. However, soils from the control plots with population density of 5 and 15plants/1m row were

slightly acidic while those with population density of 10 and 20 plants/1m row were neutral in soil reaction (Table 2).

Table 1: Pre-cropping physical and chemical properties of soil and poultry manure

	Soil	Poultry manure
Soil pH	6.8	8.7
Organic carbon	0.77%	15.87%
Organic matter	1.32%	27.32%
Total Nitrogen	0.26%	0.40%
Phosphorus	24.6 mg/kg	116.181 (mg/100g)
Potassium	0.611 cmol/kg	181.368 (mg/100g)
Calcium	0.294cmol/kg	289.163 (mg/100g)
Sodium	0.372 cmol/kg	21.611 (mg/100g)
Magnesium	0.398cmol/kg	98.672 (mg/100g)
Exchangable Acidity	0.2 meq/100g	0.8 meq/100g
Sand	72.80%	
Silt	25.60%	
Clay	1.60%	
Textural class	Loamy sand	

Table 2: Post cropping physical and chemical soil properties

	Control				5 ton/ha			
	Five	Ten	Fifteen	Twenty	Five	Ten	Fifteen	Twenty
Soil pH	6.2	6.8	6.6	7.2	6.8	6.8	6.7	6.9
N %	0.18	0.19	0.18	0.19	0.21	0.20	0.20	0.20
org C %	0.55	0.57	0.56	0.57	0.62	0.59	0.61	0.61
org M %	0.95	0.99	0.96	0.99	1.07	1.03	1.05	1.06
P mg/kg	31.62	32.36	30.18	30.86	35.01	33.57	34.89	36.22
Ex A meq/100g	0.40	0.35	0.40	0.20	0.30	0.25	0.35	0.30
Na cmol/kg	0.40	0.42	0.37	0.39	0.35	0.42	0.41	0.39
K cmol/kg	0.59	0.60	0.52	0.57	0.55	0.62	0.62	0.58



Ca cmol/kg	0.33	0.33	0.31	0.33	0.32	0.35	0.35	0.32
Mg cmol/kg	0.42	0.42	0.39	0.42	0.37	0.47	0.42	0.38
sand %	72.80	70.55	73.30	70.40	69.10	69.85	70.30	68.55
clay %	1.30	1.05	1.30	1.20	1.40	1.30	1.15	1.20
silt %	25.90	28.40	25.40	28.40	29.50	28.85	28.55	30.25
Textural class	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam

Growth of *Celosia argentea* as affected by poultry manure rates and population

The effect of fertilizer was significant on number of leaves of celosia at first planting. Celosia plants from plots that received 5tons/ha PM had significantly higher number of leaves compared with those from the control plots (Table 3). However, at second planting,

Celosia plants from plots that received application of 5tons/ha PM were significantly taller compared with those from control plots (Table 3).

Conversely, the effects of population density was not significant on growth of celosia both at first and second planting, although not significant, celosia from plot planted at the rate of 15plant/1m row were taller with higher number of leaves and larger leaf area at first planting (Table 3).

The interaction of PM rate and population on growth of celosia was significant on plant height and number of leaves at first and second planting respectively. At first

planting, celosia from plots that received application of 5ton/ha PM and planted at the density of 15 plants /1m row were significantly taller compared with those in the control plots planted at the density of 20plants/1m row (Table 4). However at second planting, significantly higher number of leaves were recorded in plants from plots that received application of 5 ton/ha PM planted at the density of 10 and 15 plant/1m row (Table 4). Fresh weight of *Celosia argentea* as affected by poultry manure rates and population. The effect of fertilizer on fresh weight of celosia was not significant at first and second planting. Although not significant, total yield, stem, leaf and root fresh weight was higher in celosia from plots that received application of 5 tons/ha PM both at first and second planting respectively (Table 5).

Table 3: Growth of *Celosia argentea* as affected by poultry manure rates and population

Treatments	First planting			Second planting		
	Plant height (cm/plant)	Number of leaves	Leaf area (cm ²)	Plant height (cm/plant)	Number of leaves	Leaf area (cm ²)
Fertilizer rates						
5 tons /ha	56.95	24.13	57.80	42.89	19.22	49.23



Control	53.15	21.26	53.30	36.03	18.01	41.65
LSD	Ns	2.65	ns	5.41	ns	ns
Population						
Five	56.22	22.44	54.47	38.57	18.62	42.55
Ten	55.61	23.66	58.67	39.43	18.88	51.22
Fifteen	58.36	23.88	59.19	39.28	19.13	51.21
Twenty	50.01	20.80	49.88	40.57	17.82	36.76
LSD	Ns	ns	ns	Ns	ns	ns

Table 4: interaction of poultry manure rates and population on growth of *Celosia argentea*

Treatments		First planting			Second planting		
		Plant height (cm/plant)	Number of leaves	Leaf area (cm ²)	Plant height (cm/plant)	Number of leaves	Leaf area (cm ²)
Fertilizer rate Population							
5 tons/ha	Five	56.88	24.13	53.22	38.93	18.37	40.60
	Ten	58.54	25.67	66.87	41.90	20.17	64.29
	fifteen	61.12	25.20	65.58	44.20	20.53	61.62
	twenty	51.23	21.51	45.53	46.53	17.80	30.39
Control	Five	55.56	20.76	55.72	38.20	18.87	44.50
	Ten	52.68	21.64	50.47	36.97	17.60	38.16
	Fifteen	55.59	22.56	52.79	34.37	17.73	40.80
	twenty	48.78	20.09	54.22	34.60	17.83	43.13
LSD		14.75	ns	ns	ns	2.65	Ns

Conclusions

Celosia planted at 15 plants per plot had the tallest plants, more leaves and wider leaf area in the first planting but had more leaves than other population in the second planting, though they were not significantly different. 5ton/ha poultry manure had taller plants, more leaves and wider leaf area in both planting but only significant in the number of leaves in the first experiment and plant height in the second experiment



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