



## **Growth and Yield Performance to Plant Density of *Celosia argentea* in Anambra State, Southeastern Nigeria**

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### **Authors' contributions**

*This work was carried out in collaboration between all authors. Author CVI designed the study, carried out the experiment, managed the literature searches and produced the initial draft. All authors performed preliminary data analysis and interpreted the data. All authors read and approved the final manuscript.*

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### **ABSTRACT**

*Celosia argentea* is a tasteful vegetable with high nutritional and medicinal values. But the increasing rate of urbanization and population has resulted to low productivity coupled with high demand which outweighs supply. Adequate production is yet to be achieved due to decline in available land space for large scale production. Due to the importance of this vegetable to Nigerian diet, the utilization of the available land area wisely for sustainable production is adequate. The effects of different planting spaces (15 x 15 cm, 20 x 20 cm, 25 x 25 cm and 30 x 30 cm) on the growth and yield of *Celosia argentea* L were investigated in 2014 cropping seasons (rainy and dry seasons) at the Department of Agricultural Education Teaching and Research Farm, Nwafor Orizu College of Education Nsugbe, Anambra State. A randomized complete block design, replicated four times was used. The results were statistically analyzed using ANOVA. Results showed that growth and yield parameters of *Celosia argentea* were influenced by plant density. The planting space of

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15 x 15 cm had the highest plant height of 55.50 cm and 54.15 cm in both rainy and dry cropping seasons respectively. On yield per hectare, also, recorded the highest shoot yield of 13.05 kg/ha, 16.45 kg/ha, 17.22 kg/ha in rainy season and 8.85 kg/ha, 12.01 kg/ha and 14.03 kg/ha in dry season at harvesting intervals of 4, 7 and 10 weeks. This data showed that the planting space of 15 x 15 cm had a better performance when compared to others. It is therefore recommended for sustainable production of *Celosia argentea* in the study area.

**Keywords:** Plant density; *Celosia argentea*; growth and yield.

## 1. INTRODUCTION

*Celosia argentea* L. commonly known as plumed cockscomb is a leafy vegetable crop belonging to the family Amaranthaceae. It is one of the most versatile herbaceous plants characterized with fast growth and plays an important part in the diet of people in the tropics. It has erect stem with alternate leaves and few branches. It is propagated by seed; the seedlings emerge 5-7 days after sowing and flowering 6-7 weeks after sowing [1]. Pollination is by wind and insects especially bees and flies which visit the flowers regularly. Seed maturity starts from the basal part of the inflorescence and gradually moves up to the tip. Seeds get matured in 10-16 weeks after sowing. *Celosia argentea* is an herbaceous plant of tropical origin and is known for its very bright colours. The crop is produced in Nigeria by small scale farmers, solely or intercropped with arable starchy staples to produce enough food to satisfy their dietary and cash requirements. It is one of the leading leaf vegetables in southeastern Nigeria, where it is known as "eri ami onu" in the Igbo language meaning "as you eat you suck your fingers".

The leaves and tender stems are cooked into soups, sauces or stew with various ingredients including other vegetables such as onions, pepper, tomatoes and with meat or fish and palm oil. The young inflorescences are also eaten as potherb [1]. It has a high nutritive value, and its grains and leaves are used and processed into many food items, supplements and additives [2]. In Ethiopia and Democratic Republic of the Congo, the seeds of *Celosia argentea* are used as medicine for diarrhea, and in Ethiopia, the flowers are used to treat dysentery and muscle troubles [3]. In China and Japan, seeds extracts have traditionally been used as therapeutic drug for eye and hepatic disease [4]. It is used traditionally for the treatment of jaundice, gonorrhoea, wounds and fever. The leaves are used for the treatment of inflammations, fever and itching. The seeds are bitter, useful in blood diseases, mouth sores and are efficacious

remedy in diarrhea [5]. *Celosia argentea* has extremely high Beta-carotene in leaves, medium vitamin E, high folic acid, medium ascorbic acid, medium calcium, medium iron and 4.7% protein. Leaves contain also *amaranthine (betacyanin)*, oxalic acid (Ca. 0.2% and phytic acid (Ca. 0.12%), [6]. *Celosia* production provides a complementary source of income to small-scale farming households.

The increasing rate of urbanization and population has resulted to low productivity coupled with high demand which outweighs supply. Adequate production is yet to be achieved due to decline in available land space for large scale production. Due to the importance of this vegetable to our diet, the utilization of the available land area wisely is vital. The objective of this study was to determine the best planting space that will improve and increase the productivity of the crop so as to meet its high demand by the increasing population.

## 2. MATERIALS AND METHODS

### 2.1 Study Area

The experiment was conducted at the teaching and research farm of Department of Agricultural Education, Nwafor Orizu College of Education Nsugbe, Anambra State (6°25'N, 6°82'E) during the 2014 cropping seasons to determine the growth and yield performance to plant density of *Celosia argentea*. Nsugbe is located in the tropical rainforest zone with an annual rainfall ranging from 1,500 mm to 2,000 mm and are characterized by a bimodal rainfall pattern that peaks in July and September with a short dry spell in August [7]. The site was cleared manually using a machet.

### 2.2 Treatment and Experimental Design

The treatment consists of 15 cm x 15 cm, 20 cm x 20 cm, 25 cm x 25 cm and 30 cm x 30 cm (15 cm x 15 cm considered as a control). The

experiment was laid out in a randomized complete block design with four replications. A plot of 25 m x 25 m (0.0625 ha) was used with 16 beds of 5 m x 5 m (sub plots). The planting material was obtained from Nsugbe market in Anambra State. The experiment was conducted in two cropping seasons in 2014; each season has duration of 3 months. They were in the months of April- July for rainy season and October – December for dry season planting.

### 2.3 Land Preparation and Sowing

Site for raising seedlings was cleared using machet and trashes packed off and burned, a nursery bed of 5 m x 5 m was measured using measuring tape, measuring rope and pegs and prepared to a fine tilt. Farm yard manure at the rate of 30 t/ha was incorporated during this exercise. It was watered to field capacity once daily for 2 weeks. Seeds were sown by drilling, watered daily using watering can, other cultural practices were observed until when the seedling were ready for transplanting [7,8].

### 2.4 Transplanting

Transplanting was done in the late evening when seedlings were 40 days old after sowing and at 5-6 leaves stage. The ball of earth method of transplanting was used and transplanted according to the treatment patterns. Each seedling on treatment plot was watered to field capacity immediately after the transplanting exercise.

### 2.5 Weeding

Plots were kept weed free throughout the experiment. Hoeing and hand pulling methods were used.

### 2.6 Data Collection

Data collected include the number of branches, number of leaves per plant, plant height, girth at 5 cm and fresh leaf weight. Plant height was measured with a meter rule from the soil level to the tip of the plant at 3, 5, 7 and 9 weeks after transplanting, the number of branches and leaves were taken by visual counting within the same period. Girth at 5 cm was taken with the aid of an electronic venire caliper at 5 cm above the soil level. On yield, the shoot fresh weight

was determined by weighing after harvesting using the weighing balance. Data collected were subjected to the analysis of variance (ANOVA) using SAS (2010) and treatment means were separated using Duncan multiple range test at 5% level of probability.

## 3. RESULTS AND DISCUSSION

The results are shown in Tables 1-3 and Fig. 1.

The effects of different levels of treatments on plant height, number of branches, number of leaves and girth at 5 cm are presented in Tables 1-2 for rainy and dry season cropping respectively.

Results revealed that plant height of *Celosia argentea* was significantly influenced by the treatment levels in both rainy and dry season cropping periods (Table 1 - 2). The plot planted at 15 x 15 cm had the highest plant height of 55.50 cm and 54.15 cm in both rainy and dry cropping seasons respectively (Tables 1 and 2). This agrees with the findings of [9] which states that higher plant density decreases individual plant weight as compared to low plant population. The tall plants produced by this spacing in dry season could be as a result of shade effect and increased soil surface cover which reduced water evaporation from the soil surface [10,11]. The plots with wider spacing 30 x 30 cm and 25 x 25 cm recorded more number of leaves and branches in both cropping seasons (Table 1- 2). This could be due to wide space available for more branching and more number of leaves. This agreed with the work of [10] who reported similar result in *Talinum triangulare*.

There were differences in treatments at different harvest intervals. A harvesting interval of three weeks was adopted. The plot planted at 15 x 15 cm recorded the highest fresh weight yield (kg/ha) of 13.05, 16.45, 17.22, 8.85, 12.01 and 14.03 at harvesting interval of 4, 7 and 10 weeks in both rainy and dry cropping seasons respectively (Table 3). This could be due to more plant populations in smaller spacing. Planting closely ensure optimum utilization of available spacing for vegetable crop growth [10]. The lower yield recorded in plots treated with large spacing could be attributed to low plant population which will definitely bring about improper use of land as weed may occupy the spaces which has no economic benefit.

**Table 1. Effects of planting spacing on growth performance in 2014 rainy season**

Treatments (cm)	Plant height (cm)	No of leaves	No of branches	Girth at 5 cm
15 x 15	55.50 <sup>a</sup>	70.48 <sup>b</sup>	11.35 <sup>c</sup>	0.85 <sup>a</sup>
20 x 20	54.80 <sup>ab</sup>	75.80 <sup>ab</sup>	13.65 <sup>b</sup>	0.81 <sup>a</sup>
25 x 25	51.90 <sup>b</sup>	77.05 <sup>a</sup>	16.40 <sup>a</sup>	0.75 <sup>a</sup>
30 x 30	50.85 <sup>b</sup>	77.82 <sup>a</sup>	15.12 <sup>a</sup>	0.74 <sup>b</sup>

*Means with different superscript vary significantly at P<.05 level of probability using DMRT*

**Table 2. Effects of planting spacing on growth performance in 2014 dry season**

Treatments (cm)	Plant height (cm)	No of leaves	No of branches	Girth at 5 cm
15 x 15	54.15 <sup>a</sup>	66.08 <sup>c</sup>	10.85 <sup>c</sup>	0.73 <sup>a</sup>
20 x 20	52.80 <sup>ab</sup>	70.30 <sup>ab</sup>	12.45 <sup>b</sup>	0.70 <sup>ab</sup>
25 x 25	50.40 <sup>b</sup>	71.05 <sup>ab</sup>	15.33 <sup>a</sup>	0.68 <sup>ab</sup>
30 x 30	49.45 <sup>b</sup>	73.32 <sup>a</sup>	13.02 <sup>b</sup>	0.66 <sup>b</sup>

*Means with different superscript vary significantly at P<.05 level of probability using DMRT*

**Table 3. Effects of planting spacing on fresh weight yield/ha (kg) in both seasons**

Treatments (cm)	Rainy season			Dry season		
	4 wks	7 wks	10 wks	4 wks	7 wks	10 wks
15 x 15	13.05 <sup>a</sup>	16.45 <sup>a</sup>	17.22 <sup>a</sup>	8.85 <sup>a</sup>	12.01 <sup>a</sup>	14.03 <sup>a</sup>
20 x 20	13.03 <sup>a</sup>	15.91 <sup>b</sup>	16.10 <sup>b</sup>	7.05 <sup>b</sup>	10.67 <sup>b</sup>	12.34 <sup>b</sup>
25 x 25	12.07 <sup>ab</sup>	15.00 <sup>b</sup>	15.60 <sup>b</sup>	6.85 <sup>b</sup>	8.87 <sup>bc</sup>	10.64 <sup>c</sup>
30 x 30	12.01 <sup>ab</sup>	14.41 <sup>bc</sup>	14.88 <sup>c</sup>	5.45 <sup>c</sup>	7.67 <sup>bc</sup>	9.34 <sup>c</sup>

*Means with different superscript vary significantly at P<.05 level of probability using DMRT*



**Fig. 1. *Celosia argentea* in its natural habitat**  
*Source: Self collection*

#### 4. CONCLUSION

From the study, it was observed that growth and yield of *Celosia argentea* were highest at 15 x 15 cm spacing in both rainy and dry seasons. It is therefore recommended for sustainable production of *Celosia argentea* in Anambra State, Southeastern Nigeria.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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