Growth, dry matter accumulation and shoot yield of celosia *argentea* as affected by poultry manure and urea application

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Study was conducted to evaluate the growth, dry matter accumulation and shoot yield of *Celosia argentea* in response to different fertilizer rates at Teaching and Research Farm, Osun State University, Ejigbo Campus, Osun State, Nigeria. Seven treatments tested were: control (NO), 3 poultry manure rates (2t/ha, 4t/ha and 6t/ha) and 3 urea rates (90, 120 and 140kgN/ha). The treatments were laid out in a randomized complete block design with three replications. Growth parameters such as plant height, number of leaves, nodes and branches as well as dry matter yield were assessed. Application of the poultry manure produced taller plants, more profuse leaves and branches and higher shoot dry matter yield compared to either the inorganic N source (Urea) or the control treatment. Among the poultry manure rate, 6t/ha produces significant higher shoot yield of celosia at harvest (2.8g) which was not significantly different from (2.7g) produced by the application of 140kgN/ha urea. It could be concluded that application of 140kgN/ha Urea or 6t/ha compost is sufficient for optimum performance of celosia in the similar agro-ecological zone.

**Key words:** Celosia, urea, compost, shoot yield, dry matter.

**INTRODUCTION**

*Celosia argentea* is one of the important leafy vegetable in south-western, Nigeria. It is a vegetable of high economic value particularly in the dry season, as it provides a source of living for most rural vegetable farmers (Akinfasoye et al., 2008). The leaves and succulent stem are consumed as vegetable because it constitutes a cheap and rich nutrient source for the low income earners, and the seeds could also be processed into food items, supplement and additives. It also has some medicinal properties for examples, in Kenya, the Ma sai use the liquid extract from the leaves and flowers to bath a patient recovering from illness and also as an antidote for snake bites. The root is also used to treat chronic eczema and, gonorrhea while the seeds are also used to treat diarrhea (Denton et al., 2004).

One of the reasons for the increased interest in celosia is because of its nutritional qualities, it has been reported to contain, protein, 4.7g, Fat 0.7g, Carbohydrate, 7.3g, Fiber 1.8g, water 83.8g, calcium, 260mg, phosphorous 43mg, Iron 7.8mg, Per 100g edible portion. (Leung et al., 1968). Celosia thus has high potentials for reducing malnutrition which is rampant in Nigeria.

A major problem facing the production of celosia in Africa is the poor soil condition as a result of continuous cultivation. To alleviate this problem the use of organic manure especially poultry droppings and ruminant dung is common with farmers in Nigeria for the production of this vegetable. Organic manure helps to improve the physical condition of the soil and provides adequate amount of necessary nutrients for soil productivity, in addition to being a major contributor of plant nutrients (Adeyeye, 2009).

The use of inorganic fertilizer has been on the decline by farmers because of its high cost and scarcity. Also the fear of soil and water pollution by inorganic fertilizers calls for the use of organic manure that are renewable and less
harmful (Eligiator, 1998) organic fertilization has been reported to produce better yield of crops that keep produce longer and more nutritious than inorganic fertilizers (Yinda and Adeoye 1994, Adediran et al., 1998). Also organic materials including crop residues, animal manure, sewage sludge and composted organic matter have been reported to favour high yield and quality of food crops (Asuegbu and Uzo 1984).

It has become relevant to carry out more researches in order to come up with organic manure (poultry manure) rates that would be comparable or superior to the expensive mineral fertilizer formulation in crop production. Hence the objectives of the study are:

(a) To evaluate the effects of poultry manure and urea on growth and dry matter yield of celosia.

(b) Determine the optimum rate of application of poultry manure and N-fertilizer on the shoot yield of celosia.

MATERIAL AND METHODS

Field experiments were conducted at the Teaching and Research Farm Osun State University, Ejigbo Campus, Osogbo, Nigeria. The experimental site has two rain periods between April to July and September to October with an average annual rainfall of 1104.0mm collected during the year of the experiment. Pre-cropping soil sample was done and the chemical laboratory analysis shows that on the average, it has pH 5.8 (1:2.5 soil: water). Total N, 0.11gkg⁻¹, available P, 12.31ppm, exchangeable Ca, 5.49cmolkg⁻¹, Mg 0.74cmolkg⁻¹, Na 0.03 cmolkg⁻¹, and K 0.27 cmolkg⁻¹. The chemical analysis of the organic manure used indicated pH (H₂O) 7.9 and 2.27, 2.12, 0.22, 3.62, 0.49, % for organic matter N, P, K, Ca, and Mg respectively.

The treatments evaluated were Fertilizer rate (90, 120 and 140KgN/ha), poultry manure of (2, 4 and 6 t/ha) and a control which were laid out in a randomized complete block (RCBD) in three replications. The poultry manure treatments were applied by spreading and mixing the manure with the soil using a hoe, one week before planting while urea fertilizer treatments were applied using side placement method a week after germination.

Each replicate comprises of 7plots which gives a total of 21 experimental plots. The plot size was 2m x 1m (2m²) with 1m gap between plot and 2m between replicates. The total land area for the experiment was 22m x 14m (308m²). Plant spacing was 30cm X 10cm. A week after germination, plants were thinned to 20 plants per row, making a total of 40 plants per plot.

Weeding was done four times starting from 2 weeks after planting and continued every two weeks by the use of hoe.

Data collected on plot basis were plant height, number of leaves and nodes, fresh shoot weight, dry matter yield of root, stem and leaves. Destructive sampling method was used at 6, 7, 8 and 9 weeks after planting and at every sampling period, 3 plants per plot were removed and measurements were taken. Plant were later separated into root, stem and leaves and oven dried at 72°C for 48 hours to constant weight to obtain dry matter yield.

The data collected were subjected to Statistical analysis of variance (ANOVA) at 5% level of probability and different means were separated using the Duncan, Multiple Range Test.

RESULTS

Effect of fertilizer treatments was significant on the number of leaves at 6WAP only. At this age application of poultry manure at 6t/ha produced significantly higher number of leaves which was similar to those plants that were treated with 140kgN/ha urea and 4t/ha poultry manure, but the lowest number of leaves was obtained for the control treatment (Table 1).

The number of nodes was not significantly influenced by the treatments application at different weeks after planting. However the highest number of nodes (12.90cm) was obtained from plants that received poultry manure of 6t/ha at 8 weeks after planting, while the least (7.33cm) was obtained from plants that were treated with 90kN/ha urea and the control (Table 2).

The stem height of celosia was significantly affected by the application of 4t/ha poultry manure at 6, 7 and 8 weeks after planting but at 9 weeks after planting there was no significant difference among the treatments applied (Table 3).

The treatments applied had a significant effect on the dry stem weight of the plant at 6 and 7 weeks after planting, poultry manure rates of 8t/ha and 6t/ha had the highest stem weight which was not significantly different but better than other treatments at all the growth stages compared except at 9 weeks after planting where there was no significant difference between treatments (Figure 1).

Dry root weight was significantly affected by the applied treatments only at 6, 7 and at 8 weeks after planting when the optimum dry not weight was recorded. There was no

<table>
<thead>
<tr>
<th>Table 1. The effect of poultry manure and urea fertilizer on the number of leaves of Celosia argentea</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fertilizer type</strong></td>
</tr>
<tr>
<td>PM1 (2t/ha)</td>
</tr>
<tr>
<td>PM2 (4t/ha)</td>
</tr>
<tr>
<td>PM3 (6t/ha)</td>
</tr>
<tr>
<td>N1 (90kg N/ha)</td>
</tr>
<tr>
<td>N2 (120kg N/ha)</td>
</tr>
<tr>
<td>N3 (140kg N/ha)</td>
</tr>
<tr>
<td>PM0N0 (Control)</td>
</tr>
</tbody>
</table>

WAP: week after planting

*Means with the same letters within the Column are not significantly different at P< 0.05
Table 2. The effects of poultry manure and urea fertilizer on the number of nodes of *Celosia argentea*.

<table>
<thead>
<tr>
<th>Fertilizer type</th>
<th>6WAP</th>
<th>7WAP</th>
<th>8WAP</th>
<th>9WAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM1 (2t/ha)</td>
<td>7.6a</td>
<td>9.1a</td>
<td>10.3a</td>
<td>11.1a</td>
</tr>
<tr>
<td>PM2 (4t/ha)</td>
<td>10a</td>
<td>10a</td>
<td>11.7a</td>
<td>11.1a</td>
</tr>
<tr>
<td>PM3 (6t/ha)</td>
<td>9.2a</td>
<td>9.7a</td>
<td>12.9a</td>
<td>12.2a</td>
</tr>
<tr>
<td>N1 (90kg N/ha)</td>
<td>8.1a</td>
<td>9.2a</td>
<td>9.1a</td>
<td>10.8a</td>
</tr>
<tr>
<td>N2 (120kg N/ha)</td>
<td>7.3b</td>
<td>6.7a</td>
<td>9.6a</td>
<td>8.7a</td>
</tr>
<tr>
<td>N3 (140kg N/ha)</td>
<td>9.7a</td>
<td>8.6a</td>
<td>10.7a</td>
<td>10.1a</td>
</tr>
<tr>
<td>PM0N0 (Control)</td>
<td>7.3a</td>
<td>9a</td>
<td>10a</td>
<td>8.2a</td>
</tr>
</tbody>
</table>

WAP: week after planting
*Means with the same letter within the column are not significantly different at P< 0.05

Table 3. The effects of poultry manure and urea fertilizer on the stem height of *Celosia argentea*.

<table>
<thead>
<tr>
<th>Fertilizer type</th>
<th>6WAP</th>
<th>7WAP</th>
<th>8WAP</th>
<th>9WAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM1 (2t/ha)</td>
<td>9.9abc</td>
<td>13.2ab</td>
<td>13b</td>
<td>18.3a</td>
</tr>
<tr>
<td>PM2 (4t/ha)</td>
<td>12a</td>
<td>16.3a</td>
<td>21.9a</td>
<td>16.3a</td>
</tr>
<tr>
<td>PM3 (6t/ha)</td>
<td>11.5ab</td>
<td>12ab</td>
<td>17.7ab</td>
<td>17.3a</td>
</tr>
<tr>
<td>N1 (90kg N/ha)</td>
<td>6.8c</td>
<td>10.3ab</td>
<td>15.3ab</td>
<td>15.7a</td>
</tr>
<tr>
<td>N2 (120kg N/ha)</td>
<td>7.8bc</td>
<td>8.8b</td>
<td>13b</td>
<td>14.2a</td>
</tr>
<tr>
<td>N3 (140kg N/ha)</td>
<td>12.1ab</td>
<td>11.6ab</td>
<td>17.3ab</td>
<td>16.6a</td>
</tr>
<tr>
<td>PM0N0 (Control)</td>
<td>7.8bc</td>
<td>12.6ab</td>
<td>16.4ab</td>
<td>11.6a</td>
</tr>
</tbody>
</table>

WAP: week after planting
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Application of poultry manure at the rate of 6t/ha significantly increased dry leaf weight at 6 and 7 weeks after planting while at 9 weeks there was no significant difference among treatments (Figure 3). At this growth stages, 6t/ha poultry manure rate gave the highest value (0.42g) while urea of 90kgN/ha gave the least (0.14g) however control had the overall least value of (0.09g).

The fertilizer treatments had no significant effect on the fresh root weight except at 9 weeks after planting through poultry manure at the rate of 6t/ha (Figure 4).
The treatments applied had significant effect on the fresh shoot yield at 6 and 7 weeks after planting. But there was no significant difference among the treatments applied at 8 and 9 weeks after planting. Poultry manure rate of 6t/ha and 140kg N/ha urea had significantly higher fresh shoot yield which was significantly different from other treatments applied (2.8g and 4.5g) respectively.

Application of 4t/ha and 6t/ha poultry manure produced the highest values of 1.33g and 1.30g respectively for fresh root weight at 8 weeks after planting while at 9 weeks, poultry manure rate of 6t/ha and Urea at 120kg N/ha produced the highest value for fresh root weight (Figure 5).

**DISCUSSION**

The differences in the number of leaves for celosia plants treated with fertilizer agreed with the finding of Olubunmi et al., (2011) that put the order of increases in number of
leaves of *celosia argentea*, with the highest from poultry manure application follow by NPK, cow dung, urea and least with the control or zero application. The stem height of the plant was significantly affected by the application of poultry manure at 6, 7 and 8 weeks after planting. This result could be due to the release of other nutrient elements (apart from Nitrogen) by poultry manure such as macro nutrient elements like P, K, Ca, Mg and little amount of trace elements such as Mn, Fe, Cu and Zn contrary to the supply of only nitrogen by urea fertilizer (Ayeni, 2011). Also earlier workers like Ehigiatior,(1998) identified manures as possible alternative sources of nutrients to inorganic fertilizers in crop production especially vegetables. This is because organic manure is storehouse of not only primary, but secondary and trace elements. (Janiok, 1986, Plaster 1992).

Poultry manure had the highest dry matter yield compared to urea and control. This disagrees with the findings of AVRDC, (1994) that dry matter yield have proportional to the quantity of Nitrogen (N) in the waste and to the quantities of inorganic fertilizer applied to the leafy vegetables. This result is in line with that of Aliyu, (2002, 2003), who reported significant response in yield to different types of manure rate application and source.

Application of 6t/ha poultry manure and urea of 140kgN/ha had a significantly higher fresh shoot yield of *celosia* in the study. This result reconfirms the work of Maheshbabu et al., (2007), who reported that manure acts as nutrients reservoir and upon deposition they are released slowly during entire growth periods leading to higher seed yield and yield components. It also agrees with shippers, (2000) that recorded significantly increased in the green leaf yield of celosia.

**Conclusion**

Organic manure is an essential additive for enhancing soil nutrient status and increasing crop production without any detrimental effect on the soil. The required quantity varies with the intensity of cropping, crop combination and types of crop grown. Besides improving the organic matter content of soils, poultry manure is a good source of nitrogen and it also possess some of limiting value which could help to reduce acidity of the soil (Nyamangara et al., 2009).

The Poultry manure application was significant in Celeosia total growth and dry matter accumulation. The rate of 6t/ha compost was significantly higher than urea in most parameter taken except for fresh shoot yield at 6 and 7 weeks after planting when application of poultry manure at 6t/ha and urea at 140kgN/ha produced significantly higher shoot yield of 2.8g and 2.6g respectively, compared with other treatments, while at 9 week after planting all treatments showed no significant difference. Therefore, poultry manure at the rate of 4 to 6t/ha is optimum for the cultivation of *celosia argentea* in South West Nigeria, and should be harvested between 6 to 8 weeks after planting for consumption to allow better yield.

**REFERENCES**


