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EFFECT OF DIFFERENT ORGANIC FERTILIZER TYPES ON THE GROWTH AND YIELD OF *Celeosia argentea* (Lagos spinach) IN JOS, PLATEAU STATE, NIGERIA

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ABSTRACT
Celosia argentea is leafy vegetable grown in West Africa mostly in Southern part of Nigeria, it is an edible leaf. This experiment was conducted to determine the effect of poultry and cow dung manure on the growth and yield of *C. argentea*. The study was carried out at Federal College of Forestry Jos, for a period of 8 weeks. A Randomized Complete Block Design (RCBD) was used in 3 treatments and replicated. Data were collected on leaf count, plant height, leaf area, stem girth, total weight of fresh and dried harvest of *C. argentea*. Analysis of Variance indicated that poultry and cow dung manure had significant ($p<0.05$) differences on the growth and yield of *C. argentea* when compared to the control. However T_2 (poultry manure) showed a very high significant effect in all parameters measured followed by T_1 (cow dung manure) compared to the control (T_3) which had the lowest yield.

Keywords: Poultry and Cowdung manure, Celosia argentea, Yield, and Growth

Introduction

Celosia is primarily used as a leafy vegetable. The leaves and tender stems are cooked as soups, sauce or stews with various ingredients including other vegetables such as onions, hot pepper and tomato, with meat or fish and palm oil. *Celosia* leaves are tender and break down easily when cooked for a short time. An experiment in Nigeria showed that, the yield of a well-managed crop harvest by uprooting was 47t/ha, while repeated cuttings was 57t/ha. Repeated cuttings also led to a better quality of the produce and higher economic return. Although *celosia* is a productive leafy vegetable, its yields are lower than those of amaranth (Denton, 2004).

According to Akinfasoye *et al.*, (2008) the Institute of Agricultural Research and Training (IART) recommended 25t/ha of farmyard manure for any vegetable. This should be evenly broadcast before planting and will supply 125kg of potassium oxide (K_2O), 75kg phosphorus oxide (P_2O_5) and 125kg of nitrogen. Deficiency of nitrogen results in stunted growth, yellowing of the lower leaves and elongated storage leads to drying of the leaves. Excess nitrogen results in excessive delay in vegetative growth, maturity and lodging. It also makes the plant more susceptible to diseases and insect attack. Phosphorus is another nutrient element needed by plant. It stimulates early root development, flowering, seed and fruit formation, crop maturation and increase crop resistance to diseases. However, deficiency of phosphorus leads to purplish colour of the leaves in young plant (Akinfasoye *et al*, 2008).

Makinde *et al*., (2011), reported that *Celosia argentea* and *Corchorus olitorus* responded differently to the treatments in relation to growth parameters with NPK fertilizer having the highest agronomic parameters while cow dung and poultry manure had the highest agronomic parameters in *Celosia argentea*. The vegetables fertilized with urea have the highest plant height and least stem girth compared with cow dung, poultry manure and NPK fertilizer. The *Celosia* and *Corhorus* treated with poultry manure had better yields, higher moisture contents in plants tissue than vegetables that were fertilized with urea. Poultry manure had the highest leaf, stem and root moisture. Urea also had the highest plant height compared with the control, and all the treatments significantly increased number of nodes, leaves, height and plant girth. The soil samples treated with cow dung had the highest number of nodes and plant height while poultry manure had the highest number of leaves, branches and girth.

Akinfasoye *et al*., (2008), reported that poultry manure compost application rates had significant effect on all growth parameters considered. Growth increases with increasing rates of compost, but 4t/ha of compost produced the highest dry matter

accumulation. However, no significant difference was obtained between the effects of 4.0 and 6.0 t/ha on the growth of the plant (*Celosia*). Growth also increased with spacing but had no significant difference on plant height, stem girth and number of leaves per plant. Ojeniyi and Adegboyega (2003) reported that goat manure increased height, number of leaves, stem girth, root length, stem and leaf weight of *celosia* when compared with urea or goat dung alone. Combined application of urea and goat dung increased growth and yields of celosia and leave nutrients contents. According to Adenipekun and Kassim (2006), the ability of *celosia argentea* to thrive in soils supplement with varying concentration of 0.2% - 0.3% of spent engine oil in a green house was investigated. The height of the plant decreased as the concentration of spent engine oil increased. After two weeks of treatment, the height of *Celosia argentea* in the control soil was 2.6cm. The plants grown in soil with 0.2% oil had the mean height of 2.55cm and 0.23cm with 3.0% spent engine oil concentration. After three weeks in the treated soil, the leaf area reduced from 30.81cm^2 in the control to 0.52m^2 as the engine oil concentration increased to 0.8%. Similar results were obtained after 5 weeks of planting with a reduction in leaf area from 24cm^2 in the 0.8% spent engine oil in soil. These values were significantly different from the control. The leaf number in the control was higher than number grown on treated soil at every stage of the experiment. The concentration of spent engine oil had effect on the moisture content of *Celosia argentea.* The moisture content increased from 83.23% in control to 90.7% with 1% spent engine oil concentration, followed by a gradual decrease to 81.82% at 3.0%. The stem girth at the 4th week was 0.83cm for the control and reduced to 0.12cm at 0.8%. At higher concentration, the value became negligible. The same reduction in girth was observed after the fifth and sixth week of growth. Results showed that spent engine oil had inhibitory effects on the growth parameters in *Celosia argentea*.

Materials and Methods

Study Area

The experiment was carried out at Federal College of Forestry, Jos Plateau State of Nigeria. The area lies between the Southern limit of Guinea Savannah and Northern limit of the Guinea Savannah ecological zones (Latitude 7^0 and 11^0 North, longitude 7^0 and 25^{0}East). The area is 1200m above sea level with annual rainfall ranging between 146mm – 148mm with a temperature range between 10^0 and 32^{0}C annually. The soil is loamy, sandy and light to darkish brown in colour. It is well drained and aerated.

Materials

The materials used for the experiment include: seed of *Celosia argentea*, hoe, cutlass, measuring tape, ruler, watering can, peg and thread, book, pencil and eraser.

Source of Materials

Seeds of *Celosia argentea* were sourced from National Horticultural Research Institute (NHORT), Ibadan Nigeria. Source of manure was from Federal College of Forestry, Jos.

Planting Method

The manure was broadcast on each plot-15kg on each plot and was left for seven (7) days, before it was incorporated into the soil except for the control which was not treated. After incorporation, the plots were irrigated immediately. The seed were planted directly on the beds using drilling method at a depth of 3cm ad spacing of 25cm x 25cm on each plot which gave a total of 25 plants per bed and 225 plants for the nine (9) plots. The study was arranged on an RCBD with three replications and 3 treatments.

Treatment 1 (T1) = Cow dung manure
Treatment 2 (T2) = Poultry droppings
Treatment 3 (T3) = Control (no poultry droppings or cow dung manure)

The width of the experimental site was 7.7m while the length is 7.7m which gave a total gross plot of 59.29m^2. The whole experimental area was divided into three block representing three replications. Each block was further subdivided into three plots. The bed was raised up to 15cm to ensure good drainage and adequate soil aeration for the plant growth (Kareem, 2008). The unit plot size of 1.5cm x 1.5cm which will give a total net plot of 13.5cm^2 with discard area between each plot and block at 0.8m.

Parameters Assessed

The parameters assessed were:

Growth Parameters

Plant height, Leaf count, Collar girth, Leaf area, number of leaves

Yield Parameters

Fresh weight of leaves
Dry weight of leaf

Mode of Data Collection

Growth parameter

Plant Height: This was determined by measuring the height using measuring tape.

Leaf Area: This was determined by adopting the method of Sharma *et al*., (1987) as length x broadest width.

Leaf Count: This was determined by counting the numbers of the leaves from each treatment. The average in each of the three (3) replicates were recorded for each treatment.

Yield parameter

$$\text{Weight of Leaves} = \frac{\text{Weight of Fresh leaves}}{\text{Weight of Dry leaves}} \times 100\%$$

Data Analysis

The data collected were subjected to analysis of Variance (ANOVA) to determine the effect of organic manure (poultry droppings and cow dung) on the growth and yield of *Celosia argentea* at 5%

probability level. Means separation was carried out using Least Significant Different (LSD).

Soil Analysis

Soil samples were collected before land preparation using soil auger, hand trowel and polythene bag. Soil samples were collected from different spots in the experimental field at two soil depths (0 – 15cm, and 15 – 30cm). These samples were mixed together in equal proportion and packed in an air tight transparent polythene bag, which was taken for analysis at Agricultural Services and Training Centers (ASTC), Vom laboratory.

Results and Discussion

Plant Height

Results in Table 3 show that T_1 (Cow dung) and T_2 had the highest (8.05 and 8.89) mean value at 2 weeks after sowing while at 4, 6 and 8 weeks, T_2 had the highest (48.10, 62.70 and 120.8) mean values respectively with the T_3 (control) having the least at 2,4,6 and 8 weeks after sowing. Analysis of variance shows that there was significant difference ($P \geq 0.05$) among treatments at 2, 4, 6 and 8 weeks and there was no significant difference ($P > 0.05$) among the blocks. The result obtained shows that there was improvement in the growth and development of *C. argentea*, and this may be because the nutrients from both treatments are available for the growth and development of the plant.

Stem girth

However, stem girth shows that T_1 (cow dung) and T_2 (Poultry droppings) had the highest (1.40 and 1.29) mean values as 2 weeks after sowing while at 4, and 8 weeks, T_2 had the highest (48.10, 5.65 and 31.7) mean values respectively with the T_3 (control) having the least at 2, 4, 6 and 8 weeks after sowing (Table 3). Analysis of Variances shows that there was significant difference ($P < .05$) among all the treatments at 2,4,6 and 8 weeks after sowing, while there was no significant difference ($P > 0.05$) among the blocks. The results obtained shows that there was improvement on the growth and development of *C.argentea.*

Number of leaves

The results in Table 3 shows that T_1 (cow dung) and T_2 (Poultry droppings) had the highest (11.27 and 11.27) mean values as 2 weeks after sowing while at 4 weeks, T_1 had the highest (21.6) mean values, while at 6 and 8 weeks T_2 had the highest (38.07 and 88.93) mean values respectively with T_3 (control) having the least at 2, 4, 6 and 8 weeks after sowing. Analysis of variance shows that there was significant difference ($P \geq .05$) among treatments at 2, 4, 6 and 8 weeks after sowing and no significant difference ($P > 0.05$) among the blocks. The results show that there was improvement in the growth and development of *C.argentea* and this might be because the nutrients from both treatments were available for the growth and development of the plant.

Leaf area

Result (Table 3) also shows that T_1 (cow dung) and T_2 (Poultry droppings) had the highest (18.63 and 20.03) mean values as 2 weeks after sowing, while at 4, 6, and 8 weeks, T_2 had the highest (49.65, 127.37 and 158.24) mean values respectively with T_3 (control) having the least at 2,4,6 and 8 weeks after sowing. Analysis of variance shows that the treatments were highly significant ($P \geq 0.05$) within all the weeks of sowing, while the blocks showed no significant difference ($P < 0.05$). This implies that the leaves had increase in size at this stage and the nutrients from both treatments were readily available for plant development.

Fresh weight

Table 4 shows that T_2 (poultry droppings (had the highest (617.21) mean value followed by T_1 (cow dung at 239.1), while T_3 (control) had the least mean value (15.70) of fresh weight after yield. Analysis of variance (ANOVA) showed that there was significant difference in treatment at 5% probability level while no significant different at 2 weeks was recorded in the block.

Dry weight

Table 4 shows that T_2 (poultry manure) had the highest (281.46) mean value followed by T_1 (cow dung at 242.37), while T_3 (control) had the least (48.99) mean value for dry weight after yield. Analysis of variance (ANOVA) showed that there was significant difference in treatment at 5% probability level while no significant difference at 2 weeks was recorded in the book.

The physic-chemical properties of the soil samples of the experimental (Table 1) showed that the soil was sandy loam, low in total N (0.06 and 1.04) and available phosphorus (2.8 and 7.0) and available potassium (20 and 21.0). Table 2 shows the record of relative humidity and rainfall. The relative humidity was fairly stable from April-May, the period with 62.84% in May as the highest observed humidity and 31.83% in March as the lowest observed humidity. The highest rainfall was also observed in April with 11.40mm and the lowest in March with 0.69mm.

The composition of nutrients in poultry manure is higher than cow dung. Thus it is expected that poultry manure will release more nutrients to soil for vegetable up take than cow dung. From the results, it was observed that poultry droppings (manure) had the highest plant height, stem girth, number of leaves and leaf area (growth parameters) in the plant. This might be as a result of the higher presence of NPK in poultry droppings than in cow dung. The presence of Nitrogen (N) in plant tissues is known to increase its vegetative growth and chlorophyll formation for photosynthesis. Phosphorus (P) is known to increase root growth, seed formation and flower development and potassium (K)

aids in osmotic pull of water from the ground and transport to other parts of plants (Makinde et al., 2011).

The very low plant height, stem girth, number of leaves and leaf area recorded in the control shows the importance of the Nitrogen (N), phosphorus (P), and potassium (K) to the growth and development of plants. This corroborates with the earlier report of Ojeniyi and Adegboyega (2003), who reported that animal manures increased number of *Celosia argentea*. The study also showed that poultry droppings had a higher significant difference in the yield components (wet and dry) of the vegetable. This is followed by cow dung and the control with the lowest. This is consistent with the earlier reports of Ayeni (2011) who reported that poultry manure and cow dung contained Nitrogen (N), phosphorus (P), Potassium (K), calcium (Ca), Manganese (Mn), Iron (Fe), Copper (Cu) and Zinc (Zn) which are essential elements responsible for the higher growth and yield of any plant.

Conclusion

The study found that the *Celosia argentea* responded well to the treatments applied. From the result it was observed that T_2 (Poultry droppings) had the highest significant effect on the parameters measured as compared to cow dung and the control. The study therefore, concluded that the T_2 (poultry droppings) is more suitable for optimum yield in the production of *Celosia argentea*. To improve food security for its growing population, the country needs to enhance its total food production by increasing the area under production and raising the productivity levels of existing lands. This is possible by embracing the use of poultry manure to boost the quality of food production. Poultry manure is relatively resistant to microbial degradation, however, it is essential for establishing and maintaining optimum soil physical condition and important for plant growth. Poultry manure is an excellent organic manure as it contains high nitrogen, phosphorus and potassium and other essential nutrients. It adds organic matter to soil which improves soil structure, nutrient retention, aeration, soil moisture holding capacity and water infiltration.

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Table 1: Chemical and Physical Characteristics of Soil at the Experimental Site before planting

Sampling depth of soil	pH (H0)	OM (%)	N (%)	P (%)	K (cmol/kg)	Clay (%)	Silt (%)	Sand (%)	Textural class
15cm	6.30	2.07	0.06	2.8	20	6.16	0.8	85.84	Loamy sand
30cm	6.33	1.38	0.04	7.0	21.0	8.16	0.8	83.84	Loamy sand

Source: Authors Field work, 2017

Table 2: Meteorological Data for Production Period (March – June, 2013)

Months	Rainfall (mm)	Temperature (^{0}C)	Relative Humidity (%)
March	0.69	30.49	31.84
April	11.40	29.90	62.60
May	9.10	28.13	62.84

Source: Metrological station Federal College of Forestry Jos

Table 3: Influence of Poultry droppings and cow dung manure on the growth attributes of *C. argentea*

Trt	Growth Characteristics (Weeks After Sowing)															
	Plant Height				Stem Girth				Number of Leaves				Leaf Area			
	2	**4**	**6**	**8**	**2**	**4**	**6**	**8**	**2**	**4**	**6**	**8**	**2**	**4**	**6**	**8**
T_1	8.05	27.70	35.32	73.93	1.40	27.79	3.64	3.09	11.27	21.61	18.9	46.7	13.6	36.2	61.2	74.5
T_2	8.89	48.10	62.70	120.80	1.29	48.10	5.65	31.7	11.27	14.2	38.1	88.9	20.0	49.7	127.4	158.2
T_3	3.07	18.68	7.05	10.45	0.59	18.68	1.01	1.39	7.47	13.9	24.3	14.1	2.03	4.9	9.20	10.31
LSD	3.0	32.29	8.57	28.59	4.10	26.4	28.8	34.8	4.10	26.4	28.81	34.8	11.61	16.73	80.52	36.20

Table 4: Yield Characteristics

Treatment	Fresh Weight	Dry Weight
T_1	239.9	242.4
T_2	617.2	281.5
T_3	15.70	348.1
LSD	248.83	135.31
	NS	NS