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Effect of Leguminous Plant leaves used as soil amendment on the Growth of *Celosia argentea* L.

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***ABSTRACT*:** Pot experiments were conducted during the planting season of 2015 at the green house of the Federal College of Forestry, Ibadan to evaluate the effect of leguminous plant leaf compost on the growth and yield of *Celosia argentea* L. There were six treatments including control (leaves of *Chromolaena odorata*, *Cedrela odorata*, *Vigna unguiculata*, *Albizia lebbeck*, and *Mucuna poggei*) The experiment was laid out in a Complete Randomized Design (CRD) and replicated five times. Leaf composts were applied at the rate of 200g/2kg of top soil. Data were collected on plant height, number of leaves, stem girth and yield for twelve weeks. Data collected were subjected to analysis of variance (ANOVA) and significant means were separated using Duncan Multiple Range Test (DMRT). The results showed that *C.argentea* treated with *Mucuna poggei* leaf compost significantly ($p<0.05$) gave the highest plant height compared to other treatments and control. Similarly, *Mucuna poggei* leaf compost significantly ($p<0.05$) gave the highest leaves production and stem girth compared to other treatment and control. Highest yield was recorded on plant treated with *Mucuna poggei* compost (67.60g/plant). Therefore, use of *Mucuna poggei* leaf compost as soil amendment for the cultivation of leafy vegetable should be encouraged since it enhances plant growth, yield readily available and environmentally safe.

Index terms: *Celosia argentea*, compost manure, growth, soil amendment, yield

1. INTRODUCTION

Soil nutrients depletion is one of the major problems currently affecting crop production in many countries of the tropics, including Nigeria. The increase in crop cultivation with little or no soil fertility management has been one of the vital factors contributing to the reduction in natural ecological balances in the land. The effect poses great hardship for productivity increase to meet the food needs of a rapidly rising population, thus endangering food security [1]

Celosia argentea L. 'Lagos spinach' of the family *Amaranthaceae* is one of the main green leafy vegetable in West Africa. It is known as *Sokoyoto* (Yoruba) or *Farar atayyato* (Hausa) [2] They grow best in full sunlight in a well drained fertile soil. They produce flower head within eight weeks and further growth can be promoted by removing dead flowers [3]. *Celosia argentea* contains protein, fat, and varying proportions of vitamin B complex (vitamin B1, vitamin B3 e.t.c) vitamin C, vitamin E, carbohydrates such as starch, sugar and dietary minerals such as nitrogen, calcium, iron, magnesium etc. The century cultivars are usually taller (1-2 feet) than other cultivars and are bright red, yellow, orange or pink in colour[4]. It is used in Africa to help control growth of the parasitic striga plant [5] (Palada *et al* 2013). In Africa and especially Southwest Ethiopia, the stem and leaves of *Celosia* are applied as poultice and used for treating infected sores, wounds, and slum eruphons, the poultice of leaves smeared with honey are used as cooling application to inflamed area and painful infections such as buboes and abscesses. [6] Production *C. argentea* in Nigeria to meet the demand of the populace has currently decline due to soil infertility and other associated problems like pests resulting to high cost of the available produce. The diminution of soil nutrients due to continuous cropping reduces the soil organic matter, cause acidification and yield reduction of crops [7-9]. The use of inorganic fertilizer to enhance crop yields has become an important alternative for improving soil fertility and productivity. Although high crop yield are obtained with the application of inorganic fertilizers, it has both economic and environmental implications. This necessitated the search for alternative sources of maintaining the fertility of the soil. The uses of organic sources of nutrients are normally anticipated as alternatives to inorganic fertilizers due to their various negative implications. According to Makumba [10] the inability of most resource-poor farmers to afford inorganic fertilizer has made organic amendment a viable alternative source of soil fertility replenishment in low-input smallholder farming systems. The use of traditional organic materials such as crop residues and animal manure cannot alone reverse soil fertility decline because they are usually not available in sufficient quantities on most farms and their processing as well as application is labour intensive [11]. The use of tree biomass as soil amendment for crop production can offers long term solution to soil problems as compared to inorganic fertilizer and animal source of organic fertilizer Several tree biomass especially the leguminous ones such as *Gliricidia sepium, Albizialebbeck, Albizia zygia, Leucaena leucocephala* and *Azadirachta indica*t can be used as amendments to improve the fertility of soil[12]. This study was therefore conducted to assess the effect of different leguminous plant leaves used as soil amendment on the growth and yield of *Celosia argentea* by mixing the soil with leaf compost.

IIMATERIALS AND METHODS

2.1.Study Area

The experiment was conducted in a green house of the Federal College of Forestry, Jericho, Ibadan. The college is located on the Latitude $7^0$26’N and Longitude $3^0$15’E. The climatic pattern of the area is tropically dominated by annual rainfall range from 1300-1500mm and has average relative humidity of about 65% and an average temperature which is about 26^0c. The eco-climatic study of the area gives two distinct seasons; dry season, usually from November to March and the rainy season, from April to October[13]

2.2 Soil analysis

Before the commencement of the experiment, surface soil samples (0–15cm depth) were taken randomly from the college experimental sites. The samples were bulked (to make a composite sample), air dried and sieved using a 2mm sieve and analyzed for particle size, soil organic matter total N, P, K,Ca, Mg and pH. Particle size analysis was done using the hydrometer method [14]. Total nitrogen was determined by the macro-kjeldahl digestion method of Jackson[15] available P was extracted using Bray-1 extract followed by molybdenum blue colorimetry. Exchangeable cations were extracted with 1M NH4OAC (pH 7.0), potassium, calcium and sodium were determined using flame photometer and exchangeable Mg byatomic absorption spectrophotometer [16]. Soil pH was determined in 1:2 soil:water ratio using digital electronic pH meter.

2.3Experimental Procedures

Celosia argentea seeds were sourced from the National Horticultural Research Institute (NIHORT) Ibadan, and raised inside germination box packed with top soil in the Nursery of Federal College of Forestry, Ibadan. The seeds were sown using broadcasting method, watering was done daily until germination started and at three days intervals during the early growth. Fresh leaves of five leguminous plants (*Chromolaena odorata*, *Cedrela odorata*, *Vigna unguiculata*, *Albizia lebbeck*, *Mucuna poggei*) were collected from Forestry Research Institute of Nigeria Jericho Hills Ibadan, cut into pieces and poured separately into air tight buckets and allowed to decompose for a period of six (6) weeks. After decomposition, 200g of each sample were weighed out, mixed with 2kg of top soil and poured into separate polythene pots. The mixtures were allowed to stay for 2 weeks before transplanting *Celosia* seedlings. The Celosia seedlings were transplanted into the prepared poly pots three weeks after planting. The experiment was arranged in Complete Randomized Design (CRD) in five replicates

2.4.Data Collection and Analysis

Agronomic attributes such plant height, stem diameter, number of leaves and yield of *C. argentea* were measured at two weeks intervals for 12 weeks The plant height (cm) was measured with the aid of a meter rule from base to the tip of the main shoots, stem diameters (mm) were measured with the use of Venier caliper. The numbers of leaves were counted by observation and the use of hand while the yield was measured by weighing the plant after the experiment with a sensitive weighing scale. Data collected were subjected to Analysis of Variance (ANOVA) and significant means were separated using Duncan Multiple Range Test at 5% level of probability.

III. RESULTS AND DISCUSSION

The properties of the soil used for the experiment are presented in Table 1. The soil was predominantly sandy and slightly acidic (pH = 6.59), low in nitrogen (0.11%), available phosphorus (5.69mg/kg) and potassium (0.36cmol/kg). The laboratory analysis of the compost used for the experiment are shown in Table 2. The various compost used were rich in Nitrogen and phosphorous. *Mucuna poggei* compost has the highest value of Nitrogen (3.425g/kg) followed by *Chromolaena odorata*(3.194g/kg) While *Vigna unguculata* (1.436g/kg) leaves has least value of Nitrogen.

3.1Effect of leaf compost on plant height (cm)

There was a general increase in plant heights after transplanting from week one to end of the experiment (12 weeks) for all the treatments (Table 3). The *Celosia* height was significantly ($p< 0.05$) higher in the soil amended with *Mucuna poggei* leaf compost compared to other treatments. However, there were no significant differences among the heights of *Celosia* plants treated with other four leaf compost and control; though they recorded greater heights than control .This could be attributed to the fact that, the added amendment increased the supply of plant nutrient in the soil for the roots to access [17] .This confirms the suggestion by Janick [18] that higher availability of nutrients increases succulent growth of plants.

3.2Effect of leaf compost on stem girth of *Celosia argentea*

There was a similar trend on the increase in stem girth of *C. argentea* after transplanting to the end of the experiment. The stem girth increased in all the amended soil. Plants amended with *Mucuna poggei* compost significantly ($p<0.05$) gave the highest stem girth compared to other treatments. (Table.4). it recorded mean value of 0,2mm at 12 weeks of the experiment while lowest stem girth was observed in untreated soil (control) with mean value of 0.15mm

This result is however lesser when compared with application of compost for planting *Celosia* done by Sanni [19] which gave a stem girth value of $3.60cm^3$ four weeks after planting(4WAP). The higher growth observed in *Celosia* plants amended with *Mucuna poggei* could be attributed to the high total nitrogen content in the *Mucuna* leaves (3.425g/kg) table 2.

3.3. Effect of the leaf compost on *C. argentea* leaf production

Observations made on the number of leaves produced by *Celosia argentea* showed an increase from week 1 to week 12 (Table 5). *Celocia* plant treated with *Mucuna poggei* compost gave the highest number of leaves with mean value 77.12 while control has the lowest mean value of 29.12.

This indicates that *Mucuna poggei* as compost provides more yield when compared with other treatments, implying that it serves as the best amendment within the scope of the research work. *Mucuna poggei* compost significantly ($p<0.05$) gave the highest leaves production.

This result was higher than the number of leaves recorded by Babajide and Olla [20] with application of *Tithonia* compost and N-Mineral fertilizer on *Celosia* plant where they obtained mean value of 67.02 leaves.

3.4. Effect of compost on yield of *Celosia argentea*

The result showed that *Celosia* plant recorded higher yield in all the treatments compared to control. *Mucuna poggei* compost significantly ($p<0.05$) gave the highest yield of *Celosia argentea* with a mean value of 67.60g. This was followed by plants treated with *Chromolena odorata and Albizia lebbeck* with mean values of 51.80 and 51. 20 respectively. This result supported the findings of Nanjundappa [21] and Imayavarambani [22] who reported improvement in the general performance of crops which received a combination of different nutrient sources. The outstanding performance of the *Mucuna poggei* compost over other compost could be attributed to the higher level of the micro nutrients (N,P and M) that are contained in the leaves compared to others. This assumption supports Adewale [23], who reported that increase in plant growth and yield as a result of application of organic manure is predictable in manure that contained and released considerable amount N and Mg for plant use during the process of mineralization. Similarly Senjobi [24] reported that the use of organic amendments produced significant effect on the performance of *Celosia* when compared with the control plants.

3.5. Conclusion and Recommendation

The application of leguminous leaf compost amendment improved growth over the control. Treatment effects on growth of *C. argentea* applied with *Mucuna poggei* compost significantly($p<0.05$) gave better results over other composts and control Therefore, *M. poggei leaf* compost amendment is recommended for use by farmers, as it has great prospects for soil fertility improvement and they are readily available as well environmentally safe

Table 1 Physiochemical properties of experimental soil

Composition	Values
pH in H_2O	6.59

pH in KCl	6.35
Ca	4.40cmol/kg
K	0.36cmol/kg
Na	0.19cmol/kg
Mg	1.94cmol/kg
%C	1.74
Total N%	0.11
Av.P	5.69
Mn	19.79mg/kg
Fe	18.06mg/kg
Cu	0.38mg/kg
Zn	6.5mg/kg
Sand	812.0g/kg
Silt	64.0g/kg
clay	124.0g/kg
Texture class	Sandy loam

Table 2: Laboratory Analysis of nutrients present in the composts used

Samples	N(g/kg)	P (g/kg)	Ca g/kg)	Mg(g/kg)	K (g/kg)	Na(g/kg)
Albizia lebbeck	2.865	0.180	0.881	0.198	1.113	221.52
Vigna unguiculata	1.436	0.217	1.240	0.265	0.421	210.57
Mucuna poggei	3.425	0.315	1.233	0.775	2.205	1310.05
Chromolaena odorata	3.194	0.299	4.430	0.315	1.318	725.01
Cedrela odorata	3.222	0.267	3.513	0.375	2.085	1055.22

Table 3: Effect of the composts on height (cm) growth of *Celosia argentea*

	Weeks after Planting					
Treatments	**2**	**4**	**6**	**8**	**10**	**12**	**Mean**

Mucuna poggei	14.64a	16.28b	17.40a	21.58a	23.28a	25.18a	19.74a
Chromolena odorata	14.48a	15.90b	17.36a	19.34b	20.98bc	22.38bc	18.06b
Cedrela odorata	14.58a	16.30b	17.66a	18.78b	21.10bc	22.94bc	17.88b
Vigna unguiculata	14.50a	16.50b	18.34a	19.12b	20.52bc	22.66bc	18.06b
Albizia lebbeck	15.10a	17.56a	19.18a	19.92b	21.62bc	23.44b	18.36b
Control	14.70a	15.90b	17.16a	18.60b	19.78c	21.52c	17.66b
CV	3.78	4.54	4.56	4.99	5.11	4.61	3.70

NOTE: Means with the same letters are not significantly different from each other at 5% probability level.

Table 4: Effect of the composts on stem diameter of *Celosia argentea*

	Weeks after Planting						
Treatments	**2**	**4**	**6**	**8**	**10**	**12**	**Mean**
Mucuna poggei	0.13b	0.15b	0.16a	0.19ab	0.20a	0.20a	0.20a
Chromolena odorata	0.14b	0.15ab	0.17ab	0.18ab	0.20ab	0.16ab	0.16ab
Cedrela odorata	0.14b	0.15ab	0.16ab	0.17c	0.18ab	0.20ab	0.16ab
Vigna unguiculata	0.14b	0.15ab	0.17ab	0.18bc	0.19ab	0.20ab	0.16b
Albizia lebbeck	0.15a	0.17a	0.18a	0.19a	0.19ab	0.20a	0.17ab
Control	0.13b	0.15b	0.16ab	0.16c	0.18b	0.19b	0.15b

CV	9.27	10.13	8.78	7.36	7.82	6.71	8.69

NOTE: Means with the same letters are not significantly different from each other at 5% probability level

Table 5: Effect of the composts on leaf production of *Celosia argentea*

	Weeks after Planting						
Treatments	**2**	**4**	**6**	**8**	**10**	**12**	**Mean**
Mucuna poggei	10.00a	15.20bc	19.60c	46.40a	70.60a	80.20a	77.12a
Chromolena odorata	10.60a	15.60ab	21.00bc	32.40c	52.40b	63.60b	32.34b
Cedrela odorata	7.40a	16.00ab	20.80bc	28.60c	52.40b	65.40b	30.44b
Vigna unguiculata	10.40a	17.20ab	23.60ab	34.00c	49.00bc	66.00b	38.62b
Albizia lebbeck	10.00a	15.20bc	19.60c	46.40a	70.60a	80.20a	77.12a
Control	9.80a	13.40c	17.80c	30.40c	44.60c	54.40c	29.12b
CV	25.22	15.14	11.68	11.63	9.78	10.08	13.94

NOTE: Means with the same letters are not significantly different from each other at 5% probability level

Table 6: Effect of the composts on the yield of *Celosia argentea*

	Weeks after Planting
Treatments	**Weight(kg)**
Mucuna poggei	67.60
Chromolena odorata	51.80ab
Cedrela odorata	47.60ab
Vigna unguiculata	38.80b

Albizia lebbeck	51.20ab
Control	38.40a
CV	29.47

NOTE: Means with the same letters are not significant different from each other at 5% level of probability

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