Research Journal of Botany

ISSN 1816-4919

Academic Journals Inc.

www.academicjournals.com

Research Journal of Botany 6 (4): 150-156, 2011
ISSN 1816-4919 / DOI: 10.3923/rjb.2011.150.156

Comparative Effect of Mineral Fertilizers and Organic Manures on Growth, Nutrient Content and Yield of *Chorcorus olitorus* and *Celosia argentina*

[1]S. Olubunmi Makinde, [1]M. Imisu Usilo, [1]E. Adeyinka Makinde and [2]L. Samuel Ayeni
[1]Department of Botany, Lagos State University, P.O Box 0001, Ojoo, Lagos, Nigeria
[2]Department of Agricultural Science, Adeyemi College of Education, Ondo, Nigeria

Corresponding Author: Ayeni L. Samuel, Department of Agricultural Science, Adeyemi College of Education, Ondo, Nigeria

ABSTRACT

Corchorus olitorus and *Celosia argentina* are popularly consumed as vegetables in southwestern Nigeria because of their economic and nutritional importance. Therefore, pot experiments were conducted to compare the effect of poultry manure, cow dung, NPK 20:10:10 and urea fertilizers on growth, nutrients content and yield of *Corchorus olitorus* and *Celosia argentina* in Lagos southwest Nigeria. The recommended rates of NPK (400 kg ha^{-1}), urea fertilizers (200 kg ha^{-1}) and; poultry manure (10 t ha^{-1}) and cow dung (10 t ha^{-1}) were used as treatments. There was a control without any treatment. The two experiments were separately conducted in year 2010. The treatments were mixed with washed and air dried river sand. Compared with control, all the treatments significantly ($p<0.05$) increased plant height, number of leaves and dry matter yields of *Corchorus olitorus* and *Celosia argentina*. The *Corchorus* fertilized with NPK had the highest moisture content; poultry manure had the highest nutrient uptake while urea had the highest dry matter yields. *Celosia argentina* fertilized with poultry manure and cow dung recorded the highest moisture content, nutrient uptake while urea had the highest dry matter yields. The over all yield increase in relation to number of leaves of *Corchorus olitorus* are in order of NPK> poultry manure>cowdung>urea>control while increases in the leaves of *Celosia argentina* are in the order of poultry manure>NPK>cow dung>urea>control. Poultry manure, cow dung and NPK fertilizer serve as sources of nutrients for *Corchorus* and *Celosia argentina*. Poultry manure where available is better for the production of *Corchorus* olitorus and *Celosia argentina*.

Key words: Vegetable, cow dung, urea, NPK20:10:10 fertilizer, urea fertilizer

INTRODUCTION

There are many plants in the world and each of the plants has specific purpose for the benefit of mankind. Over the ages, man has attempted to collect, conserve, characterize and exchange germplasm for the development of improved varieties. Much improvement may not be feasible if the soil management is not considered alongside with the crop management.

Ever increasing population has reduced the size of the lands needed for the domestication of the plants. This has led to the use of various methods to conserve the soil for crop improvement. The use of mineral and organic fertilizers are the two major common ways in which the soils are currently managed since extinction of shifting cultivation as well as reduction in period of bush

fallow. Organically grown plants are nourished naturally, rendering the structural and metabolic integrity of their cellular structure superior to those conventionally grown. As a result, organically grown foods can be stored longer and do not show susceptibility to rapid mold and rotting. Another benefit to consumers of organic food is that it is free of contamination with health harming chemicals such as pesticides, fungicides and herbicides (Geier, 1997).

Inorganic fertilizers unlike organic fertilizers are usually quick-release formula making nutrient rapidly available to plants. Inorganic fertilizers are safe to use. However, because it is quick-releasing salts can build up fast, damaging soil (soil applications), pumps and airstones used in hydroponics application. The advantage of using inorganic fertilizers is that nutrients are immediately available to plants and exact amount of a given element can be measured before feeding plant (Stolton, 1997).

Inorganic fertilizers do not need certain time to be broken down or decomposed before usage because they contain nutrient that can be readily absorbed by plants. Inorganic fertilizers work immediately i.e., they are given as rescue treatment to plant that is malnourished, unhealthy or even dying. Among inorganic fertilizers, NPK fertilizer are designed to give plants the three major nutrients; nitrogen (N), phosphorus (P) and potassium (K) that the plants need in appropriate proportion and amount (Stolton, 1997). Also, urea fertilizer contains mainly N (46%). Nitrogen enhances the vegetative growth of plants. This unique characteristic is good for the vegetable crops that have their leaves, stems and roots edible. Fresh leaves of *Cochorus olitorus* are rich source of vitamin A and C. The small amount of protein present in it is rich in methionine. The leaves of *Corchorus olitorus* are used in the treatment of chronic cystitis, gonorrhea, dysuria, for toothache (Hillocks, 1998). A cold infusion is used as a tonic to restore the appetite and strength (Sharaf and Negm, 2005). The leaves have also been found to suppress elevation of post prandial blood glucose levels in rats and humans (Innami *et al*., 2005). The seeds are used for fever and purgative possesses broad and has antibacterial properties (Pall *et al*., 2006). Oils from the seeds are also used for skin diseases. Among the conventional fertilizers, urea and NPK fertilizers are mostly used to fertilize vegetable farms in southwestern Nigeria while among the organic manures; poultry and cow dung are popularly used for vegetable production. Hence, there is need to compare there effectiveness and usefulness in vegetable production. The objective of this study was to compare the effect of mineral and organic fertilizers on growth and yield components of *Corchorus olitorus* and *Celosia argentina* production.

MATERIALS AND METHODS

Source of materials and treatment design: Seeds of *Celosia argentena* and *Cochorus olitorus* were collected from Nigeria Institute of Horticulture, Ibadan, Nigeria. The seeds of *Celosia argentena* and *Cochorus olitorus* were raised separately in a nursery. At four leaf stage, the seedlings were transplanted into bucket filled with river sand and kept in the screenhouse at the Lagos state university.

Treatment application

***Corchorus olitorus*:** Treatment includes supplementing the soil with NPK, urea, poultry manure and cow dung. NPK fertilizer was applied the rate of 2 g/10 kg soil to represent 400 kg ha^{-1}, urea fertilizer was applied at the rate of 1 g/10 kg soil to represent 200 kg ha^{-1} while poultry manure and cow dung were each applied at the rate of 50 g/10 kg soil to give 10 t ha^{-1} recommended for optimum crop production in southwest Nigeria. Control experiment enjoyed no treatment (i.e., no

application of either organic or Inorganic nutrient). There were forty pots in all i.e., 5 treatments replicated eight times. Cow dung and poultry manure were applied two weeks before *Corchorus olitorus* seedlings were separately transplanted into the buckets in order to enhance fast decomposition. NPK 20:10:10 and Urea fertilizers were separately applied two weeks after transplanting. Equal amount of water was applied to all the treatments. After 8 weeks of growth, twenty seedlings were harvested for determination of nutrient uptake growth and yield components of *Corchorus olitorus* remaining twenty pots which were used to determine growth and yield parameters.

Celosia argentina: Twenty buckets were filled with 10 kg of river sand. The same treatments i.e., 400 kg ha^{-1} NPK20:10:10 fertilizer, 200 kg ha^{-1} urea fertilizer, 10 t ha^{-1} of poultry and cow dung were applied as carried out in *Corchorus olitorus*. Two seedlings per bucket were transplanted to each bucket. The buckets were laid out in Completely Randomized Design with five treatments replicated four times. At 8 weeks after planting, one seedling of Celosia argentina/pot was uprooted for nutrients content determination and dry matter yield leaving the remaining one plant/pot for the determination of growth and yield parameters. The different rates of fertilizers used were based on the recommended rates for optimum production of arable crops especially vegetables in southwestern Nigeria where these experiments were conducted.

Determination of growth and yield parameters of *Corchorus olitorus* and *Celosia argentina*: The growth and yield parameters taken were fresh and dried matter of stems, number of nodes on the main stem, plant height, number of branches and leaves. Others were leaf, stem, and root moisture contents. Leaves, stems and roots were harvested, weighed and oven dried at 65°C to constant weight and then reweighed to obtain dry matter yield and moisture contents. Stem girth was determined with the use of vernier calipers.

Analysis of organic manures and plant tissues: The poultry manure and cow dung used for the experiment were collected, cured for two weeks, ground with hammer mill and ashed in the muffle furnace. Digestion was carried out with a mixture of nitric-perchloric-sulphuric acid in order to extract P, K, Ca and Mg (AOAC, 1991). Total N was digested with sulphuric acid in the presence of selenium catalyst (Kjedahl catalyst) and distilled before titration. Available P was determined by Bray-1-method, K and Na by flame photometer. Calcium and Mg were read on Atomic absorption spectrophotometer. Tissue of *Celosia* and *Chocorus olitorus* were harvested at 5 weeks after planting, oven dried at 65°C until constant weight was recorded milled and analyzed.

Statistical analysis: Means of the data collected were separated by Least Significant difference.

RESULTS

Analysis of poultry manure and cow dung showed that poultry manure was richer in nutrient concentration than cow dung. Poultry manure was composed of 2.69 N, 1.70 P, 1.72 K, 11.72 Ca, 0.70 Mg and 0.22% Na, respectively while cattle dung was composed of 1.42 N, 1.10 P, 7.20 K, 13.20 Ca, 0.62 Mg and 0.65% Na, respectively.

***Corchorus olitorus*:** Compared with control, application of poultry manure, cow dung, NPK and urea fertilizers (Table 1) significantly increased ($p>0.05$) number of leaves, number of branches

Table 1: Effects of organic and mineral fertilizers on growth parameters of *Corchorus*

Character	Control	Cow dung	Poultry manure	NPK	Urea	LSD
Number of nodes	17.10	28.20	32.20	36.60	18.40	3.06
Number of branches	31.05	52.20	58.20	74.80	37.60	9.89
Number of leaves	42.68	132.80	172.20	238.20	45.60	53.31
Final height (cm)	43.00	50.20	87.00	79.00	89.80	6.83
Stem girth (cm)	0.69	1.90	1.78	3.14	0.68	0.68

Table 2: Effects of organic and mineral fertilizers on moisture contents and dry matter of *Corchorus*

Character	Control	Poultry manure	Cow dung	NPK	Urea	LSD
Leaf moisture content (%)	32.00	82.40	77.67	76.16	72.48	1.66
Stem moisture content (%)	42.11	90.23	85.14	87.47	81.03	1.76
Root moisture content (%)	41.00	82.73	77.05	80.68	60.47	2.72
Leaf dry matter	9.02	17.92	22.40	20.91	27.48	1.65
Stem dry matter (g)	4.60	9.771	14.89	12.51	20.61	1.50
Root dry matter (g)	10.05	17.27	22.95	19.32	39.53	2.72

Table 3: Effects of organic and mineral fertilizers on nutrient composition of *Corchorus olitorus* (mg kg^{-1})

Character	Control	Poultry manure	Cow dung	NPK	Urea	LSD
Calcium	0.22	9.37	0.71	4.67	1.98	1.21
Magnesium	0.31	5.53	0.48	2.83	1.08	0.90
Sodium	0.22	2.80	0.34	2.06	0.76	0.43
Potassium	0.19	2.01	0.20	0.95	0.54	0.27

Table 4: Effects of organic and mineral fertilizers on growth parameters of *Celosia*

Character	Control	Cow dung	Poultry manure	NPK	Urea	LSD
Number of nodes	27.02	53.20	30.20	46.20	39.20	4.67
Number of branches	3.09	8.40	11.60	3.40	2.40	2.90
Number of leaves	40.00	200.40	308.80	267.80	138.20	53.31
Final height (g)	30.07	140.00	108.00	133.20	84.00	9.88
Stem girth (g)	1.02	5.24	5.62	5.60	3.84	0.25

(except urea), plant height and stem girth. NPK fertilizer had the highest number of nodes, number of branches and stem girth. Urea fertilizer had the highest plant height.

In Table 2, among the treatments, poultry manure recorded the highest leaf moisture. leaf moisture content in *Corchorus olitorus* increased in the following order Poultry manure>cow dung>NPK fertilizer>urea>control. Poultry manure also had the highest root moisture content the soil samples treated with urea fertilizer had highest leaf, stem and root dry matter yields.

In Table 3 compared with control, all the treatments increased N, P, Ca, Mg, K and Na. poultry manure significantly recorded highest Ca, Mg and K while urea fertilizer had the highest N. NPK fertilizer recorded the highest P.

***Celosia argentina*:** Table 4 shows the growth parameters of *Celosia argentina* when fertilized with poultry manure, cattle dung, NPK fertilizer and urea fertilizer. Compared with control, 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 the poultry manure had the highest leaves, number of branches and highest girth.

Table 5: Effects of organic and mineral fertilizers on moisture content and dry matter of *Celosia* (%)

Character	Control	Poultry manure	Cow dung	NPK	Urea	LSD
Leaf moisture content (%)	70.01	83.77	80.69	83.34	74.45	1.11
Stem moisture content (%)	72.01	89.50	83.65	88.34	79.54	1.50
Root moisture content (%)	60.11	83.72	78.67	82.67	64.55	0.95
Leaf dry matter (g)	16.09	16.21	19.31	16.57	25.55	1.11
Stem dry matter (g)	7.24	10.41	16.35	11.66	20.61	1.50
Root dry matter (g)	12.88	16.28	26.10	17.33	27.79	5.90

Table 6: Effects of organic and mineral fertilizers on nutrient content of *Celosia* (mg kg^{-1})

Character	Control	Poultry manure	Cow dung	NPK	Urea	LSD
Calcium	0.45	11.62	0.67	5.25	1.88	1.28
Magnesium	0.46	7.95	0.66	3.80	1.22	0.90
Sodium	0.36	4.62	0.51	2.31	0.87	0.52
Potassium	0.11	3.41	0.32	1.45	0.82	0.38

Table 5 shows the moisture content of leaf , stem and root; leaf, stem and root dry matter of *celosia argentina* when poultry manure, cow dung, NPK fertilizer and surea fertilizer were individually applied to *Celosia argentina*.

Poultry manure had the highest leaf, stem and root moisture contents. Urea fertilizer had the highest increase in leaf, stem and root dry matter contents. Urea also had the highest plat height.

Table 6 show that relative to control experiment, *Celosia argentina* significantly increased ($p>0.05$) N, P, K Ca, Mg and Na. celosia grown in the soil samples that contained poultry manure absorbed more P, Ca, Mg, Na and K that all other treatments.

DISCUSSION

The nutrients composition of poultry manure was higher than cow dung; thus it was expected that poultry manure would release more nutrients to the soil for vegetable uptake than cow dung. The washed river sand used for the experiment was known to be very low in plant nutrients. This would allow the treatments applied to exhibit their chemical properties in releasing nutrients to the soil for plant use.

It was observed that NPK 20:10:10 fertilizer had the highest number of nodes, branches and stem girth while urea fertilizer had the least number of nodes, branches and stem girth in *Corchorus olitorus*. This might be as a result of N, P and K present in NPK fertilizer. The presence of N in plant tissue is known to increase its vegetative growth and chlorophyll formation for photosynthesis. Phosphorus is known to increase root growth, seed formation and flower development. Potassium aids in osmotic pull of water from the ground and transport to other parts of the plant. Potassium also helps in sugar formation. The very low number of leaves, branches and stem girth recorded by both plants treated with urea fertilizer and control experiment shows the importance of P and K. Urea mainly supplied N with no addition of other nutrients. This shows that crop fertilized with only urea fertilizer would suffer deficiency of other nutrients but would enjoy luxurious consumption of N. This could also be the reason why P, K, Ca, Mg and Na were very low in *Corchorus* and *Celosia* fertilized with urea. The river sand that had no treatment was not expected to supply adequate plant nutrient as it would be deficient in plant nutrients; hence low crop yield. The bulk of nutrients absorbed by *Corchorus* and *Celosia* in this experiment were likely to come from the treatments applied.

The results showed that *Corchorus olitorus* and *Celosia argentina* responded differently to the treatments in relation to growth parameters. NPK fertilizer had the highest agronomic parameters while cow dung and poultry manure had the highest agronomic parameters in *Celosia argentina*. The difference between the responses of the two vegetables to fertilizers applucation on growth might be a genetic factor as the two vegetables were subjected to the same nutrient and environmental condition.

The vegetables fertilized with urea had the highest plant height and least stem girth compared with cow dung, poultry manure and NPK fertilizer. The tallness of the plants might be as a result of high amount of N. Urea fertilizer contains 46% in its formulation. The plants were tall but slender because there was no Ca to strengthen the plant and K to counteract the negative effect of over dosage of N in the plants. Plants can only perform well when they enjoy balanced nutrition. *Celosia* and *Corchorus* treated with poultry manure had better yields because they enjoyed balanced nutrition. Poultry manure and cattle dung contained N, P, K, Ca, Mg and little amount of trace elements such as Mn, Fe, Cu and Zn (Ayeni, 2011).

It is argued that organic manures are usually late in nutrient mineralization. This was the reason why poultry manure and cow dung were cured and applied two weeks before the planting of *Corchorus* and *Celosia*. The major parts of the nutrient present in poultry manure and cow dung would have mineralized before the termination of the experiment. Ayeni (2011) and Ayeni and Adeleye (2011) in the experiments conducted on the rate of nutrient release by poultry manure showed that larger proportions of its nutrients were released between one to two months of incubation.

Celosia argentina and *Corchorus* fertilized with poultry manure, cow dung and NPK fertilizer had higher moisture contents in plants tissues than the vegetables that were fertilized with urea. This might be as result of higher nutrients content especially K in these vegetables. It has earlier been stated that K plays significant role in water transport and plant turgidity. The low moisture in the control experiment might be inability of the plant to absorb adequate water from the soil.

The results from this study conform to similar researches on the effect of different nutrient sources on the growth and yield of *Corchorus* and *Celosia*. Fawusi (1983) reported increase in the yield and nutritional value of *Corchorus* on application of NPK fertilizer. This study also corroborates with earlier report of Opeyemi and Adegboyega (2003), who reported that animal manures increased number of leaves, stem girth, root length, stem and leaf length of *Celosia* and also leaf N, P, K, Ca and Mg contents compared to urea. Combination of urea with poultry manure was also reported to have increased leaf yield (Bobatola and Oycdummade, 1992) which also conform to the observation recorded from this study.

CONCLUSION

Pot experiments were carried out to determine the effect of poultry manure, cow dung NPK20:10:10 fertilizer and urea fertilizer on growth and nutrient uptake of *Corchorus olitorus* and *Celosia argentina*. The treatments increased the yields and nutrients uptake of the two vegetables. Among the treatments, poultry manure compared favourably with NPK fertilizer in yield parameters. Poultry manure, cow dung and NPK fertilizer serve as sources of nutrients for *Corchorus* and *Celosia argentina*. Poultry manure where available is better for the production of *Corchorus* olitorus and *Celosia argentina*.

REFERENCES

AOAC, 1991. Official Methods of Analysis. Association of Analytical Chemist, Washington DC., USA., Pages: 247.

Ayeni, L.S. and E.O. Adeleye, 2011. Soil nutrient status and nutrient interactions as influenced by agro wastes and mineral fertilizer in an incubation study in the South West Nigeria. Int. J. Soil Sci., 6: 60-68.

Ayeni, L.S., 2011. Effect of sole and combined cocoa pod ash, poultry manure and NPK 20:10:10 fertilizer on soil organic carbon, available P and forms of nitrogen on alfisols in Southwestern Nigeria. Int. Res. J. Agric. Sci. Soil Sci., 1: 77-82.

Bobatola, J.O. and E.E.A. Oycdummade, 1992. Influence of organic manures and urea on nematode pests of *Gelosia argenta*. Nematol. Medit., 20: 237-239.

Fawusi, M.O.A., 1983. Quality and compositional changes in *Corchorus olitorius* as influenced by nitrogen fertilizer and post harvest handling. Sci. Hortic., 21: 1-7.

Geier, B., 1997. Organic farmers: A world of difference. J. Sustainable Agric., 15: 57-60.

Hillocks, R.J., 1998. The potential benefits of weeds with reference to small holder agriculture in Africa. Integr. Pest Manage. Rev., 3: 155-167.

Innami, S., H. Ishida, K. Nakamura, M. Kondo and K. Tabata *et al.*, 2005. Jews mellow leaves (*Corchorus olitorius*) suppress elevation of postprandial blood glucose levels in rats and humans. Int. J. Vitamin Nutr. Res., 75: 39-46.

Opeyemi, S.O. and A.A. Adegboyega, 2003. To investigate the separate and combined effects of urea and goat dung on leaf nutrient contents, growth and yield of *Celosia argentea* in Southwest Nigeria. Niger. Agric. J., 34: 87-90.

Pall, D.K., M. Mandal, G.P. Senthilkumar and A. Pahiari, 2006. Antibacterial activity of *Cuscuta reflexa* stem and *Corchorus olitorius*. Fototerapia, 77: 589-591.

Sharaf, A. and S.A.R. Negm, 2005. Pharmacological study of *Corchorus olitorius* L. seeds with special reference to its cardiovascular activity. Plant Foods Hum. Nutr., 17: 305-312.

Stolton, S., 1997. Ecology and farming. Int. Mag. IFOAM, 15: 35-37.