# Comparing the use of *Tithonia diversifolia* and Compost as soil amendments for growth and yield of *Celosia argentea*

Shokalu, Adekemi Olubukola *[1], Ojo, Aderemi O.[2] Ezekiel-Adewoyin, Dorcas Tinuke[3] and Azeez, Jamiu Oladipupo[4]

[1]National Horticultural Research Institute, P.M.B. 5432, Idi- Ishin, Ibadan, Nigeria

[2]Institute of Agricultural Research and Training, Ibadan, Nigeria

[3]Federal College of Agriculture, I.A.R. & T., Ibadan, Nigeria

[4] Department of Soil Science and Land Management, University of Agriculture, Abeokuta, Nigeria

*Corresponding author kemishokalu@yahoo.co.uk, (+234 80 3636 9814)

**ABSTRACT:** Field experiment was conducted between June and September in the 2007 and 2008 cropping seasons at the teaching and experimental research field of the National Horticultural Research Institute ($7^0$25"N and $3^0$52"E), Ibadan, Oyo State, Nigeria, to compare the growth and yield of *Celosia argentea* L. using different rates and sources of organic amendments and also evaluate the effect of the amendments on soil chemical properties. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replicates the plot size was 4 $m^2$. *Tithonia diversifolia* (chopped, fresh leaves and young stem) was applied at 0, 2.5, 5, 7.5, 10 and 20 tons $ha^{-1}$ and compost (made from cassava peels + poultry manure at ratio 3:1 on dry weight basis) at the same rates. These treatments were incorporated into the soil two weeks before planting. Agronomic data and soil chemical parameters were subsequently collected. Results indicated that soil P, Ca, CEC, K and soil organic matter content were significantly ($P < 0.05$) improved by the addition of both compost and *Tithonia.* There were no significant effect of compost on soil pH, N, Mg and Zn, but these parameters were significantly ($P < 0.05$) improved with the use of *Tithonia*. The plant's number of leaves, plant height and stem girth increased significantly ($P< 0.05$) with the application of both compost and *Tithonia;* though compost amended plots gave higher values. Mean yield for two years in the compost amended plots was significantly ($P < 0.05$) higher (45.52 tons $ha^{-1}$), compared with that observed for *Tithonia* (40.17 tons $ha^{-1}$) amended plots. Compost amendment at 20 tons $ha^{-1}$ produced the highest yield of *Celosia argentea.* [New York Science Journal 2010; 3(6):133-138]. (ISSN 1554 – 0200).

**Keywords: Celosia, *Tithonia*, compost, soil amendments.**

## 1. Introduction

The Food and Agricultural Organisation (FAO) in 2004 developed a programme focused on production and utilization of fruits and vegetables. The framework of the programme was to promote increased production, availability, access as well as consumption of fruits and vegetables. A daily intake of at least 400 g was recommended by FAO/WHO for households (FAO 2004). To achieve increased vegetable production, there is the need for the development of proper soil and crop management. Sustainable soil management is essential for sustainable crop production. Soil systems exposed to a variety of environmental stresses of natural and anthropogenic origin can potentially affect soil functioning, soil productivity and consequently, crop yield. In addition, with continuous use and increased crop yield over time, a need will arise to provide supplementary nutrient sources for the soil to meet nutrient requirement of crop, in addition to maintaining soil fertility. Application of organic matter is accepted as a good soil management practice in sustainable crop production because it enhances soil fertility through the modification of soil physical, chemical and biological properties (Haering and Evanylo, 2005). Application of organic materials such as animal manure, green manure, plant residue and composted organic matter have been reported to produce high yield and quality food crops (Asuegbu and Uzo 1984). Some workers have also reported positive response in vegetables grown under both organic and inorganic fertilizer management (Taiwo et al, 2007; Akinfasoye and Akanbi, 2005; Seck, 1998).

*Tithonia diversifolia* is an invasive, annual weed, growing aggressively along road path, abandoned farmlands and hedges all over Nigeria. It has been used successfully to improve soil fertility and crop yields in Kenya (Jama *et al*., 2000), Malawi (Ganunga *et al.*, 1998), Nigeria (Ayeni *et al*., 1997), Rwanda (Drechsel and Reck, 1998) and Zimbabwe (Jiri and Waddington, 1998). It is also found to be available in Cameroon, Uganda and Zambia. It has different uses, including use as ornamental plant, animal feed (Farinu *et al*., 1999; Olayemi, 2006) insecticide (Akanbi *et al*., 2007), nematicide and soil fertility improvement (Jama *et al*, 2000). Other uses of tithinia includes; mulching, fodder, fencing and as local herbs.

Compost consists of the relatively stable decomposed organic materials resulting from the accelerated biological degradation of organic material under controlled, aerobic conditions (Storey, 1995; Epstein, 1997). Compost fertilizer is made from plant and animal remains with the objective of recycling for crop production. The decomposition process converts potentially toxic or putrescible organic matter into a stabilized state that can improve soil for plant growth. Compost fertilizers can be used as mulch, for weed control as well as soil fertility improvement. (Roe *et al.*, 1997).

Composted organics has other beneficial effects, including diverting landfill wastes to alternative uses, removal of pathogen inocula or weed seeds and decomposition of petroleum, herbicide or pesticide residues, erosion control and as a nutrient source for sustainable re-vegetation of degraded soils. Compost fertilizer is made from plant and animal remains with the objective of recycling plant and animal remains for crop production. Compost application to commercial vegetable crops in Nigeria has gained little attention, though it has been reported to improve yield.

The objectives of this study therefore, are: (1) to compare the growth and yield of *Celosia argentea* L. using different rates and sources of organic amendments and (2) to evaluate the effect of the amendments on soil chemical properties.

## 2. Material and Methods

Field experiment was conducted at the teaching and research field of National Horticultural Research Institute (NIHORT), Ibadan, Nigeria ($7^0$25"N and $3^0$52"E) during the 2007 and 2008 cropping season. Soil samples were collected to the depth of 0-15cm, air dried, sieved (2 mm) and analysed by standard procedures (Page *et al.*, 1939). Compost was made from cassava peels and cured poultry manure at the ratio of (3.1) on dry weight basis. The compost preparation procedure of Adediran *et al.*, (2006) was adopted. Fresh leaves and soft young stems of tithonia was chopped and used as a green manure. The experiment was laid out in a randomized complete block design (RCBD) with three replicates. Treatments include: 0, 2.5, 5, 7.5, 10 and 20 tons $ha^{-1}$ of compost and *Tithonia diversifolia*, were incorporated into the soil two weeks before planting. *Celosia argentea* seeds (TLV 8) were mixed with dry fine sand (2 mm) and drilled at 50cm spacing on plot size of 4 $m^2$. Four plants per plot were randomly selected and tagged for agronomic data collection: plant height, stem girth, number of leaves from five weeks after planting on weekly basis. Yield data (fresh weight of young stem and leaves) started at 7 weeks after planting, with subsequent harvests done fortnightly. Post planting soil sample analyses was carried out after harvests. Plant samples were randomly selected for tissue nutrient concentrations after harvest. Soil and plant sample analyses were carried out by standard procedures (Page *et al.*, 1982). Data collected were analysed by SAS 2000 and significant treatment means were separated by DMRT ($P<0.05$).

## 3. Results

Average rainfall data of the experimental site is presented in Figure 1. Total rainfall was higher in 2008 than in 2007. The physicochemical properties of the soils used for the experiments are presented in Table 1. The soils are sandy loam, low in organic carbon, nitrogen and phosphorus. The soil pH is slightly acidic. Cationic concentration was generally low with a predominantly higher Ca content.

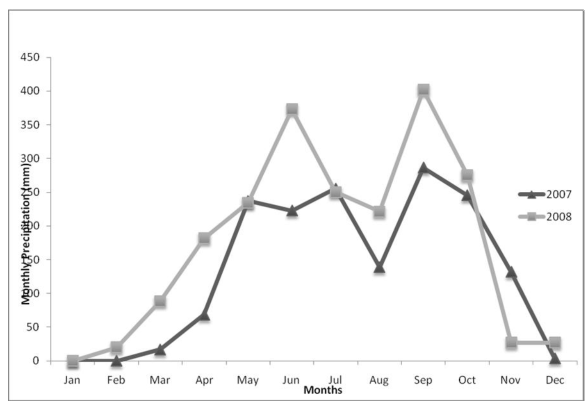


**Figure 1: Rainfall pattern for 2007 and 2008 at Ibadan, Southwest Nigeria.**

**Table 1: Pre-planting physico- chemical properties of soils of the experimental site.**

| Soil property | pH | O.C | N | Ca | Mg | Na | K | Exch acidity | ECEC | Av.P | Cu | Zn | Fe | Mn | Textural Class |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | % | | | | C mol kg $^{-1}$ | | | | | mg kg $^{-1}$ | | | | |
| **2007** | **5.8** | **0.98** | **0.07** | **2.95** | **0.89** | **0.46** | **0.35** | **0.08** | **4.73** | **1.10** | **0.39** | **1.31** | **7.55** | **39.9** | **Sandy** |
| **2008** | **6.2** | **1.11** | **0.08** | **1.80** | **0.74** | **0.35** | **0.21** | **0.06** | **3.16** | **1.95** | **0.34** | **1.18** | **6.15** | **45.45** | **loam** |

Table 2 shows the proximate analysis of the organic materials used in the experiment. Tithonia had a higher N content of 1.59 % than compost. Phosphorus and K for Tithonia were lower than compost.

**Table 2: Proximate Analysis of Organic Materials used for the Experiment.**

| Proximate Analysis | Total N | P | K | Ca | Mg | Mn | Cu | Zn | Fe | Na |
|---|---|---|---|---|---|---|---|---|---|---|
| | % | | | | | | | | | |
| Tithonia | 1.59 | 0.09 | 0.07 | 0.11 | 0.004 | 0.002 | 0.003 | 0.044 | 0.27 | 0.15 |
| Compost | 1.20 | 0.28 | 3.77 | 2.86 | 0.28 | 0.01 | 0.001 | 0.007 | 0.08 | 1.58 |

Table 3 shows the effect of treatments on plants height, stem girth and number of leaves of Celosia. Highest plant heights were recorded with compost at 20 tons ha$^{-1}$. Plots treated with compost and Tithonia significantly had higher growth parameter values than control. Stem girth of celosia amended with Tithonia was however higher than compost amended plots. Yield was highest with the application of 20 tons ha$^{-1}$ compost (45.52 tons ha$^{-1}$), but Tithonia was also comparable at 20 tons ha$^{-1}$ with fresh yield of 40.17 tons ha$^{-1}$. However, 10 tons ha$^{-1}$ of both compost and Tithonia produced optimum yield of *Celosia argentea*

**Table 3: Growth response of *Celosia argentea* L. to different sources of organic amendments.**

| Treatment (tons ha$^{-1}$) | Number of Leaves Tithonia | Number of Leaves Compost | Plant Height (cm) Tithonia | Plant Height (cm) Compost | Stem Girth (cm) Tithonia | Stem Girth (cm) Compost | Yield (tons ha $^{-1}$) Tithonia | Yield (tons ha $^{-1}$) Compost |
|---|---|---|---|---|---|---|---|---|
| 0 | 11.88c | 10.37c | 11.42c | 9.37c | 1.82c | 1.28c | 23.70c | 21.45c |
| 2.5 | 14.25b | 14.75b | 14.48bc | 13.01bc | 2.15b | 1.65ab | 29.02bc | 23.45c |
| 5.0 | 15.82ab | 14.85b | 14.97b | 13.22bc | 2.41ab | 1.54ab | 34.23b | 30.87b |
| 7.5 | 16.12ab | 16.35b | 14.91b | 16.17b | 2.65a | 1.87ab | 34.31b | 32.35b |
| 10 | 15.25b | 15.52b | 15.18b | 17.11b | 2.45ab | 2.10a | 40.00a | 45.16a |
| 20 | 17.50a | 18.58a | 20.21a | 24.95a | 2.67a | 1.85ab | 40.16a | 45.52a |

*Means with the same letters are not significantly different at $p<0.05$*

Tables 4 and 5 present the effect of Tithonia and compost on soil properties. Use of compost did not significantly affect soil N, Zn, pH, Mg, these values were not significantly different from control, compost however improved soil P, K and Ca. Tithonia on the other hand improved soil P, K, Ca, organic matter, and CEC were all improved with the use of both Tithonia and compost, but Tithonia amendments gave higher values than compost for these properties. Na content was not significantly affected by both compost and Tithonia.

**Table 4: Effect of different sources of organic amendments on soil N, P, K and Ca**

| | N | | P | | K | | Ca | |
|---|---|---|---|---|---|---|---|---|
| | % | | mg kg$^{-1}$ | | C mol kg -1 | | | |
| Treatments (tons ha$^{-1}$) | Tithonia | Compost | Tithonia | Compost | Tithonia | Compost | Tithonia | Compost |
| 0 | 0.09b | 0.39a | 4.60c | 4.60f | 0.16c | 0.16b | 0.83d | 0.81e |
| 2.5 | 0.09b | 0.39a | 5.42b | 4.90e | 0.25b | 0.09b | 0.85d | 0.84d |
| 5.0 | 0.09b | 0.39a | 5.49b | 5.20d | 0.09c | 0.17b | 0.91c | 0.86c |
| 7.5 | 0.09b | 0.39a | 5.85ab | 5.65c | 0.27b | 0.20b | 0.92bc | 0.88b |
| 10 | 0.10b | 0.39a | 6.15a | 5.89b | 0.25b | 0.19b | 0.94b | 0.88b |
| 20 | 0.13a | 0.69a | 6.30a | 6.20a | 0.41a | 0.27a | 0.98a | 0.92a |

*Means with the same letters are not significantly different at $p<0.05$*

**Table 5: Effect of different sources of organic amendments on soil properties.**

| | pH | | OM | | CEC | | Zn | | Mg | | Na | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | % | | | | C mol kg -1 | | | | | |
| Treatments (tons ha$^{-1}$) | Tithonia | Compost | Tithonia | Compost | Tithonia | Compost | Tithonia | Compost | Tithonia | Compost | Tithonia | Compost |
| 0 | 6.55b | 7.00a | 1.14e | 1.19e | 2.16d | 2.15b | 6.66c | 7.01a | 0.74e | 0.81a | 0.26a | 0.28a |
| 2.5 | 6.65ab | 6.55a | 1.27d | 1.25d | 2.32c | 2.22b | 6.82bc | 7.81a | 0.78d | 0.82a | 0.30a | 0.26a |
| 5.0 | 6.75ab | 6.65a | 1.28cd | 1.28c | 2.34c | 2.28b | 6.80bc | 7.05a | 0.82bc | 0.85a | 0.26a | 0.27a |
| 7.5 | 6.90ab | 6.85a | 1.33bc | 1.24d | 2.36c | 2.43a | 7.43ab | 7.60a | 0.81cd | 0.87a | 0.25a | 0.29a |
| 10 | 6.80ab | 6.50a | 1.37b | 1.35b | 2.50b | 2.48a | 7.12ab | 7.40a | 0.84b | 0.88a | 0.31a | 0.29a |
| 20 | 7.60a | 7.67a | 1.45a | 1.42a | 2.65a | 2.55a | 7.55a | 7.45a | 0.89a | 0.96a | 0.29a | 0.19a |

*Means with the same letters are not significantly different at $p<0.05$*

It was observed in Table 6 that there was no significant increase in the concentrations of N and Ca in Celosia tissues with the addition of compost. Application of Tithonia increased the N and Ca concentrations in Celosia tissue, but not for P. Zn was significantly increased with the application of both compost and Tithonia while there was no effect of both on K.

**Table 6: Effect of different sources of organic amendments on Celosia tissue nutrient concentrations (%).**

| | N | | P | | K | | Ca | | Zn | |
|---|---|---|---|---|---|---|---|---|---|---|
| Treatments (tons ha$^{-1}$) | Tithonia | Compost | Tithonia | Compost | Tithonia | Compost | Tithonia | Compost | Tithonia | Compost |
| 0 | 0.60d | 0.75a | 0.28a | 0.22d | 4.15a | 4.31a | 0.86b | 0.76a | 109b | 103c |
| 2.5 | 0.70cd | 0.76a | 0.29a | 0.27cd | 4.20a | 4.09a | 0.87b | 0.82a | 114ab | 111bc |
| 5.0 | 0.79bc | 0.78a | 0.41a | 0.31bc | 3.57a | 3.22a | 0.93b | 0.82a | 114ab | 115ab |
| 7.5 | 0.83ab | 0.80a | 0.43a | 0.36ab | 5.31a | 3.73a | 0.95b | 0.84a | 115ab | 115ab |
| 10 | 0.85ab | 0.82a | 0.40a | 0.41a | 3.24a | 3.53a | 0.98b | 0.87a | 116ab | 116ab |
| 20 | 0.96a | 0.93a | 0.32a | 0.43a | 6.08a | 6.80a | 1.20a | 0.95a | 119a | 122a |

*Means with the same letters are not significantly different at $p<0.05$*

## 4. Discussion

The result of this trial showed clearly the potentials of organic materials in improving soil properties. This is expected because of the increase in soil organic matter and micronutrient contents of the soil. Compost produced a higher yield than tithonia because of its stabilized properties. Better yield observed for both organic sources could be attributed to the higher nitrogen availability and beneficial effects of these materials. This is similar to the results obtained by Olabode *et al*., 2007, Ademiluyi and Omotosho, 2007 and Akanbi *et al.*, 2007, who obtained better crop yields for both compost and/or tithonia. However, proper management of tithonia, by processing into tithonia compost will further improve the manural effects and even give better yield as suggested by Akanbi *et al.*, 2007 who reported higher shoot yield of *Telfaria occidentalis* with tithonia composts.

The findings that the application of both tithonia and compost increased the plant uptake of these nutrients are indicative that these materials are good sources of plant nutrients. These materials are also able to retain plant nutrients for a longer time. The increased nutrient uptake and soil concentration of these materials suggests a direct effect of available nutrients and plant nutrient uptake.

This study showed that compost and tithonia green manure can be used to improve crop yield and promote sustainable food production by improving soil properties. Composting also improves the quality of materials of soil amendments. Compost and tithonia at 10 tons $ha^{-1}$ is recommended.

**Corresponding Author:**
Shokalu Adekemi Olubukola
Vegetable and Floriculture Department
National Horticultural Research Institute
P. M. B. 5432, Ibadan, Nigeria.
E-mail: kemishokalu@yahoo.co.uk

## REFERENCES

1. Adediran, J. A., Taiwo, L.B., Akande, M.O., Lawal, B.O., 2006. Working manual on Composting Technology and Utilization. A guide for extension agents, farmers, compost makers and users. Ed. by Adeoye G. A. and Akinlosotu T. A.
2. Ademiluyi, B. O., Omotosho, S.O., 2007. Comparative evaluation of *Tithonia diversifolia* and NPK fertilizer for soil improvement in maize (*Zea mays*) production in Ado Ekiti, Southwestern Nigeria. American-Eurasian J. Sustainable Agric. 1(1), 32-36.
3. Akanbi, W.B., Adebayo, T.A., Togun, O.A., Adeyeye, A.S., Olaniran, O. A., 2007. The Use of Compost Extract as Foliar Spray Nutrient Source and Botanical Insecticide in *Telfairia occidentalis.* World J. Agric. Sci.3 (5), 642-652.
4. Akinfasoye, J. A., Akanbi W. B., 2005. Effect of organism, fertilizers and spacing on growth and yield of celosia (*Celosia argentea* L.); In proceedings of the Hort. Soc. Nig. Pp 61- 66.
5. Asuegbu J. E., J. O. Uzo, 1984. Yield and yield components; Response of Vegetable crops to farm yard manure rates in the presence of inorganic fertilizers on the growth and yield of maize. J. Agric. Univ. Puerto Rico 68, 238-243.
6. Ayeni, A. O., Lordbanjou, D. T., Majek, B. A., 1997 *Tithonia diversifolia* (Mexican Sunflower) in south-western Nigeria: Occurrence and growth habit. Weed Res. (Oxford) 37, 443–449.
7. Drechsel, P., Reck B., 1998 Composted shrub-prunings and other organic manures for smallholder farming systems in southern Rwanda. Agrofor. Sys. 39, 1–12.
8. Epstein, E., 1997. The science of composting. Technomic Publishing Co., Inc., Lancaster, Pennsylvania. 487 pages.
9. FAO, 2004. Fruit and Vegetables for Health Report of a Joint FAO/WHO Workshop, 1–3 September 2004, Kobe, Japan
10. Farinu, G. O., Odunsi, A. A. Togun, V. A., 1999. Effects of varying levels of mango-seed kernel on growth, performance, nutrient digestion and blood composition of weaner rabbits. Trop. J. Anim. Sci. 3, 199 - 225.
11. Ganunga, R, Yerokun, O., Kumwenda, J. D. T., 1998. *Tithonia diversifolia*: an organic source of nitrogen and phosphorus for maize in Malawi. In: Waddington SR et al. (ends) Soil Fertility Research for Maize-Based Farming Systems in Malawi and Zimbabwe, pp 191–194. Soil Fert Net and CIMMYT-Zimbabwe, Harare, Zimbabwe.
12. Haering, K., Evanylo G., 2005. Composting and Compost Use for Water Quality, In Composting resource directory.
13. Jiri, O., Waddington, S. R., 1998. Leaf prunings from two species of tithonia raise maize grain yield in Zimbabwe, but take a lot of labor! Newsletter of Soil Fert Net, Harare, Zimbabwe. Target 16, 4–5.
14. Jama, B., Palm, C. A., Buresh, R. J., Niang, A., Gachengo, C., Nziguheba G.,

Amadalo, B., 2000.*Tithonia diversifolia* as a green manure for soil fertility improvement in western Kenya: A review. Agrofor. Sys. 49, 201–221.

15. Olabode, O.S., Ogunyemi S., Akanbi, W.B., Adesina G.O., Babajide, P.A., 2007. Evaluation of *Tithonia diversifolia* (Hemsl.) A Gray for Soil Improvement. World J. Agric. Sci. 3 (4), 503-507.
16. Olayeni T. B., G. O. Farinu; V. A. Togun; O. S. Adedeji and A. O. Aderrinola, 2006. Performance of haematological characteristics of Weaner Pigs fed with Sunflower (*Tithonia diversifolia* Hemsl. A Gray) leaf meal. J. Anim. Veter. Adv. 5(6), 499-502.
17. Roe N. E., Stofella, P.J., Graetz, D. A. 1997. Compost from various municipal Waste feedstocks affect vegetable crops II. Growth, yield and fruit quality. J. Am. Soc. Hort. Sci. 122, 433-437.
18. Page A.L; Miller, R.H. and Keeney D.R. (ed.) 1982. Methods of soil analysis, Part 2: Chemical and microbiological properties, 2nd edition, Agronomy 9, soil Science Society of America, Madison. U.S.A
19. SAS 2000. Statistical Analytical System, 2000
20. Seck, M. A., 1998; Two compost types used in the Niayes (Senegal) market garden area, technological innovation and vegetable production. Acta Hort. 469, 325-331.
21. Storey, B.B., McFalls, J.A., Godfrey. S.H., 1995. The use of compost and shredded brush on rights-of-way for erosion control: Final report. Texas Transportation Institute. Texas A&M University System. College Station, Texas.
22. Taiwo L. B., Adediran J. A., Sonubi O. A, 2007; Yield and quality of tomato grown with organic and synthetic fertilizers. Int. J. Veg. Sci. 3(2), 5-19.

26/04/10