The Effects of Organic and Inorganic Fertilizers on the Growth Performance of *Celosia argentea* L.

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Abstract: Pot experiments were conducted to determine the effects of organic and inorganic fertilizers on the growth of *Celosia argentea* L. The experiment was laid in Completely Random Design with five treatments. NPK and Urea (200kgha^{-1}) and 6t ha^{-1}of cow dung and poultry manure were used. The results revealed that cow dung manure treated seedlings produced the highest growth at 6 weeks after transplanting (6WAT) followed by poultry manure. Urea fertilizer produced the highest number of leaves at harvest. NPK fertilizer produced the highest leaf area. NPK, Urea and poultry manure had similar stem girth. Urea treated seedlings had the highest number of green leaves. NPK fertilizer treated seedlings showed the highest number of spikes followed by poultry manure. Cow dung treated seedlings with NPK had the similar relative growth rates. All the parameters accessed showed that the control experiments had the least growth. Statistical analyses (ANOVA, $P < 0.05$) showed that significant differences were observed in the growth parameters studied when the treatments were compared to the control experiment except the relative growth rate that showed no significant difference from the control experiment. It was observed that organic fertilizer performed better in some parameters accessed on the growth of *C. argentea*. It is suggested that organic fertilizers (poultry and cow dung) might be a good option of fertilizers in the cultivation of this vegetable by the farmers who cannot afford the price of inorganic fertilizers.
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1. Introduction

The consumption of indigenous leafy vegetables in south western Nigeria has greatly reduced due to urbanization and increased population. Urbanization led to deforestation of agricultural lands for construction of social amenities such as schools, hospitals, stadia and so on. The traditional farming system of shifting cultivation and related bush fallow that required soil nutrients to be regained over period of years is no longer attainable. Deforestation and reduced fallow period might justify the reason why the indigenous vegetables are fading off. Also, people's choice is now shifting from indigenous vegetables to exotic ones planted in urban areas.

The reduced fallow period and continuous cropping of farmlands lead to soil nutrients depletion that reduced the yield of crops and vegetables. The depleted soil needs to be ameliorated with fertilizer to increase the growth and yield of these crops and vegetables (Oroka, 2012). The use of naturally produced fertilizer is now globally advocated because the products from it are considered safe for humans (Fabiyi *et al*., 2015). Also, Law-Ogbomo *et al*. (2011) noted the complementary use of organic and inorganic fertilizers have been proved to be a sound soil fertility management strategy.

The indigenous vegetables had been reported to have an important role in a well-balanced diet (Vaishli and Varsha, 2013). They are nutritious with protein or fat (Whitaker, 2001). They contain various proportions of vitamins, dietary minerals and carbohydrates with other nutrients (Kratzer and Vohra, 1986, Faber *et al*., 2002 and Gruda, 2005). Vaishli and Varsha (2013) noted that indigenous leafy vegetables are good source of nutrition at low cost and are easy to cook as it gives a very good taste even without addition of additives. They provide a well-balanced diet in the recent years where lesser amount of red meat and more vegetables and fruits are advocated (Arne *et al*., 1996 and Lucarini and Canali, 1996). They played a vital role in the nutrition and the health status of the under-privileged in both rural and urban areas (Haddad, 2003 and Oniango *et al*., 2003).

The increased decline in soil fertility and crop productivity in the tropics necessitated the use of inorganic fertilizer to boast crop productivity. The continuous use of inorganic fertilizers have been reported to influence nutrient imbalance, nitrate pollution, microbial activities, soil acidity and fatal threats to man and yield reduction (Akanbi 2002, Babajide *et al*., 2008 and Ajilore, 2008).

The trend in the world today is shifting towards the use of organic fertilizers in the production of agricultural crops vegetables. The consumption of organically produced food is safer for the health status of mankind (Fabiyi *et al*., 2015). Law- Ogbomo and Ajayi (2009) noted that there was an increase demand

for vegetables in urban areas where people are not involved in its primary productivity.

Akanbi *et al*. (2007) and Chukwuka and Omolayo (2009) had earlier reported the sustainability of organic materials such as crop residues and animal manure as potential sources of nutrients of inorganic fertilizer. Organic fertilization has been reported to produce better yields of crops that keep longer and more nutritious than inorganic fertilizers (Yinda and Adeoye, 1994; Adediran *et al*., 1999). Organic fertilizer improves soil physical and microbial activities, eliminates pollution and supply plant nutrients, acts as a major contributor to the cation exchange capacity and as a buffering agent against undesirable fluctuations (Olaniyi and Ojetayo, 2012).

Weber *et al*. (2007) and Asgharipour (2012) noted that organic matter possess many desirable properties such as high water holding capacity, enhanced nutrient uptake and beneficial effects on the physical, chemical and biological characteristics. The high cost of inorganic fertilizer and its associated problems such as hazardous environmental consequences necessitated the alternative methods of improving the soil nutrients with naturally produced organic fertilizer. Oyedeji *et al*. (2014) noted that inorganic fertilizers are uneconomical and is out of reach to the poor resource farmers who dominate the Nigeria Agricultural sector.

Celosia argentea (Lagos spinach) is a leafy vegetable with high nutritious value (Aladesanwa *et al*., 2001). It belongs to the family Amaranthaceae. It is a leafy vegetable popularly known in south western Nigeria (Schippers, 2000). It is commonly found in traditional intercropping system of the tropics (Olufolaji and Ayodele, 1998). It thrives well in well-drained soil with a pH of 6-6.4 (Gill *et al*., 1999). The leaves and young shoots are succulent, rich in protein, vitamins and minerals such as calcium, phosphorus and iron and are used in soup (Akanbi *et al*., 2007., Akinyemi andTijani- Eniola, 1997). Also Babajide and Olla (2014) noted that boiled shoots are served with yam or yam flour, rice and so on. The leaves and flowers are edible and are grown for such in Africa and south Asia (Gruben and Dentou, 2004).

C. argentea has medicinal values in treating dysentery, diarrhoea, acute abdominal pain, inflamed stomach and skin eruptions such as snakebite and wounds (Schippers, 2000) and other traditional uses(Koh *et al*., 2009). Aruna (2009) noted that the leaves of *C. argentea* can be dried and preserved against season in India. This study is designed to evaluate the effects of organic and inorganic fertilizers on the growth of *Celosia argentea*.

2. Materials and Methods

The experiment was carried out at the experimental site of the Department of Plant Science, Ekiti State University Ado- Ekiti Nigeria ($7^0$40'N and $5^0$15'E). Ado- Ekiti is in the rainforest zone of south-western Nigeria. The experiment was carried out from October, 2014 to March, 2015. Seeds of *Celosia argentea* were collected from Ikoga market, Badagry Lagos State. Cultivated soil was obtained at 10cm depth on campus, air dried for a week and sieved through a 5mm mesh. Equal amount of soil (4.8kg) was weighed with weighing balance into planting pots. Rooting analysis was carried out and the soil was sandy clay loam with soil organic matter content of 7.54%, 0.85% N, 16.21 $mgkg^{-1}$ P, and 2150$mgKg^{-1}$ K with a pH of 7.54. The treatments included two organic fertilizers (cow dung and poultry manure) obtained from Teaching and Research Farm, Faculty of Agricultural Science in Ekiti State University, Ado-Ekiti. Inorganic fertilizers (NPK 20, 15, 15) and Urea were obtained from Agricultural Development Project (ADP), Ado- Ekiti. NPK and Urea (200$kgha^{-1}$) and 6t $ha^{-1}$of cow dung and poultry manure were used. The poultry manure was analysed to have 2.50% N, 5.13$mgkg^{-1}$P, 5856.64$mgkg^{-1}$K and pH of 7.52. Likewise, the cowdung was analysed to have 2.19% N, 4.27$mgkg^{-1}$ P, 8366.53 $mgkg^{-1}$ K with pH of 8.20. The organic fertilizers were mixed with the soil two weeks before transplanting while the inorganic fertilizers were applied into the soil two weeks after transplanting of the seedlings using the ring method. The seedlings have earlier stayed in the nursery for three weeks.

The pot experiments were laid down in Completely Randomized Design with the treatments replicated four times. A control experiment without any fertilizer was also replicated four times. The parameters assessed were weekly heights, leaf area, number of leaves at harvest, stem girth, relative growth rate, number of fruits and biomass. The data collected from the experiments were subjected to statistics using Analysis of Variance (ANOVA) and Duncan Multiple Range Test (DMRT) was used to separate the means.

3. Results

The effects of organic and inorganic fertilizers on the weekly height (cm) of *C. argentea* are shown in Table 1. It was revealed that the height of *C. argentea* increased weekly in all the treatments. *C. argentea* heights obtained in cowdung manure was the highest at 6weeks after transplanting (49.87cm) which was similar to those of poultry (47.44cm). The control experiment gave the least growth (37.22cm).

Statistical analysis (ANOVA, $P< 0.05$) revealed that no significant differences were observed in the

initial heights of *C. argentea* when the treatments were compared to the control. At six weeks after transplanting (6WAT), no significant differences were observed in the heights of C. *argentea* treated with NPK, urea and those of control experiment. No significant differences were observed in poultry manure and cowdung fertilizers treated seedlings but were significantly different from the control, urea and NPK fertilizers.

Table 1. Effects of organic and inorganic fertilizer on the weekly heights (cm) of *Celosia argentea*

Treatment	Initial height	2WAT	3WAT	4WAT	5WAT	6WAT
Control	1.90a	3.16a	12.25a	19.97b	32.35b	37.22b
PM	1.83a	2.00c	7.05a	17.43b	43.73a	47.44a
CWD	1.78a	2.66b	10.05a	25.10a	35.98b	49.87a
NPK	1.71a	3.10a	8.77a	20.60b	28.35c	33.37b
Urea	1.24a	2.13b	7.08a	13.95c	24.09c	34.19b

Mean followed by the same letter within column are not significantly different at (P<0.05).

The effects of organic and inorganic fertilizers on the mean number of leaves at harvest of *C. argentea* are shown in Table 2. The mean number of leaves at harvest (6WAT) in the control experiment was 22.00, poultry manure (51.63), cowdung (49.88), NPK (60.75) and urea (62.50). Statistical analysis revealed that significant differences were observed in the number of leaves in the treatments from 2WAT to 6WAT compared to the control experiment. No significant differences were observed in the initial number of leaves of *C. argentea* treated seedlings compared to the control experiment.

The effect of organic and inorganic fertilizers on the leaf area, number of spikes and green leaves at harvest of *C. argentea* are shown in Table 3. At 6WAT, the mean number of green leaves was 22.00 in the control experiment. Those of poultry manure treated seedlings were 51.63, cowdung (47.00), NPK (60.00) and urea (63.75). NPK fertilizer produced the highest number of spikes (17.00) and leaf area (72.63 cm^2). These were similar to the other treatments asides the control experiment that had the least leaf area (35.33 cm ^{2}) and spikes (4.50). Statistical analysis revealed that significant differences abound in the three variants compared to the control experiments.

The effects of organic and inorganic fertilizers on the stem girth and relative growth rate are shown in Table 4. NPK fertilizer produced the highest stem girth (15.75cm). The relative growth rate of poultry manure, cowdung and urea were similar. Control experiment has the least in the two parameters assessed. Significant differences were observed in the stem girth of the treated plants compared to the control experiment. The relative growth rate of the treated plants showed no significant difference from those of the control experiment.

The effects of organic and inorganic fertilizer on the biomass of *C. argentea* are shown in Table 5. It was revealed that the control experiment had the lowest fresh and dry shoot biomass (1.99g and 10.34g) respectively. Poultry manure treated plants had the highest fresh and dry root and shoot biomass with 4.71g and 2.21g respectively. Dry root and shoot biomass for poultry manure recorded the highest value with 26.55g and 6.63g respectively. Statistical analysis revealed that the fresh root biomass of the treated vegetables showed no significant difference from the control experiment. Dry root and shoot weights with fresh shoot weights of the treated vegetables showed significant differences from the control experiment.

Table 2. Effects of organic and inorganic fertilizer on the number of leaves at harvest of *Celosia argentea.*

Treatment	Initial number of leaves	2WAT	3WAT	4WAT	5WAT	6WAT
Control	5.38a	9.75b	16.75c	21.88c	30.13c	22.00c
PM	5.50a	7.50c	18.75b	40.63b	45.38b	51.63b
CWD	5.50a	6.13c	11.83d	26.88c	45.50b	49.88b
NPK	5.13a	11.25a	21.25a	54.38a	61.88a	60.75a
Urea	5.25a	11.00a	21.50a	43.63b	45.38b	62.50a

Mean followed by the same letter within column are not significantly different at (P<0.05)

Table 3. Effects of organic and inorganic fertilizer on the number of green leaves at harvest, leaf area (cm^2) and number of spikes at harvest of *Celosia argentea.*

Treatment	Number of green leaves at at harvest	Number of Spikes	Leaf area ($cm^{2)}$
Control	22.00c	4.50c	35.33d
PM	51.63b	12.50b	61.39b
CWD	47.00b	10.25b	53.61c
NPK	60.00a	17.00a	72.63a
Urea	63.75a	12.38b	62.94b

Mean followed by the same letter within column are not significantly different at (P<0.05).

Table 4. Effects of organic and inorganic fertilizer on the stem girth and relative growth rate of *Celosia argentea.*

Treatment	Stem girth (cm)		Relative growth rate
Control	13.63c		0.32a
PM	15.50ab		0.37a
CWD	14.63b		0.37a
NPK	15.75a		0.33a
Urea	15.50ab		0.37a

Mean followed by the same letter within column are not significantly different at (P<0.05).

Table 5. Effects of organic and inorganic fertilizer on the biomass of *Celosia argentea*

Treatment	Fresh root biomass	Freshshoot biomass	Dry root biomass	Dry root biomass
Control	1.99a	10.34b	0.52c	4.64c
PM	4.71a	26.52a	2.21a	6.63a
CWD	3.76a	24.82a	1.12b	5.79a
NPK	4.11a	24.82a	1.10b	6.27a
Urea	4.27a	24.47a	1.56a	6.16ab

Mean followed by the same letter within column are not significantly different at (P<0.05).

4. Discussion

The highest growth in height of *C. argentea* occurred in organic manure cow dung which was similar to that of poultry manure. This might be as a result of the highest release of nitrogen and phosphorus from the organic fertilizer. Yinda and Adeoye (1994) and Adediran *et al*. (1999) had earlier reported that organic fertilization produce better yields of crops that keep longer and more nutritious than inorganic fertilizers. Wu *et al*. (2005) noted that bio-fertilizers such as organic manures has been identified as an alternative to chemical fertilizer to increase soil productivity and crop production in suitable farming. The increase in the plant height might be due to the improved soil fertility and soil water holding capacity. This corroborated the earlier assertions of Fallah *et al*. (2007) who noted that increase in plant height can be improved by improved soil fertility.

Though Urea fertilizer produced the highest number of leaves of *C. argentea*, this was similar to poultry manure treated plants. The work corroborated the earlier assertions of Shippers (2000) who noted that poultry and cattle manure significantly increase the green leaf of *C. argentea*. Akinfasoye *et al*. (2008) reported that maize stover, poultry manure compost and spacing, single and combined influence the growth and development of *Celosia.* The highest number of leaves recorded in urea fertilizer in this study might be as a result of it being pure nitrogen. This might led to the formation of more buds and increase in the number of leaves for photosynthesis and conserve energy. This corroborated the study of Zhang *et al.* (2010) who noted that nitrogen generally stimulates vegetative growth. Olaniyi and Ojetayo (2012) and Olaniyi *et al*. (2008) reported that *Celosia* plants increased in growth with increasing rate of nitrogen fertilizer and vegetative cropping system requires a greater degree of management. They noted that nitrogen increases the cell size and cellular number resulting from cell division and expansion that leads to increased stem girth, number of leaves and other vegetative parts of the plants.

NPK fertilizer produced the highest stem girth in *C. argentea*. This observation is supported by the work of Aliyu and Olanrewaju (1996) who noted that the beneficial effects of Nitrogen, Phosphorus and Potassium could be seen in the increase of stem girth of *Capsicum annum* and thus interpreted as accumulative growth.

5. Conclusion

Inorganic fertilizers might have adverse effects on the environment causing soil burn and pollution. It is costly and needs expertise for its application.

Considering the availability and abundance of poultry manure and cowdung that are cheaper and environmental friendly, often referred to as farmers waste and does not need expert for their application. It is hereby recommended that poultry manure and cowdung might be a good option for the cultivation of *C. argentea*. Also, the vegetables produced from the organic fertilizers will be safer for human consumption.

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References.

1. Oroka, F.O. (2012). Comparative Effects of Municipal Solid Waste Compost and NPK Fertilizer on the growth and Marketable Yield of *Celosia argentea*. *New York Science* 5(10): 34-38.
2. Fabiyi, E.F Ademiluyi, B. O. and Abiodun, J. (2015). Comparative Evaluation of Organic and Inorganic Manure on Sweet Pepper Performance in Two Ecological Zones of Nigeria. *American Journal of Experimental Agriculture* 6(5): 305-309.
3. Law- Ogbomo, K.E., Remison, S.U.and Jombo, E. O. (2011). Effects of organic and Inorganic fertilizers on the productivity of *Amaranthus cruentus* in an Ultisols Environment. *International Journal of Plant Physiology and Biochemistry* 3(14): 247- 252.
4. Vaishali, S. K. And Varsha, D. J. (2013). Traditional Leafy Vegetables: A future Herbal Medicine. *International Journal of Agricultural and Food Science* 3(2): 56-58.
5. Whitaker, J.M. (2001).Revising Diabetes: Warner Books, New York.
6. Kratzer, F. And Vohra, P. (1986).The effects diet on plasma lipids, lipoprotein and coronary heart diseases *J. Am. Diet. Assoc*., 88: 1373-1411.
7. Faber, F.M. Phungula, M.A.S. Venter, S.L., Dhansay, M.A. and Benade, A.J.S. (2002). Home gardens focusing on the production of yellow and dark- green leafy vegetables increase the serum retinol concentrations of 2-5 years old children in South Africa. *American Journal Clin, Nutri*., 76: 1048-1054.
8. Gruda, N. (2005). Impact of Environmental factors on product quality of green house vegetables for fresh consumption. Crit. *Rev. Plant Sci*., 24: 227-247.
9. Arne, S.B. Gold, L.S. (1996). Mom was right at least about fruits and vegetables. *Chem. Heal Safe* 3: 17- 21.
10. Lucarini, S. And Canali, R. (1996). National Research Council, Carcinogens in the human diet. (National Academy Press, Washington). Pp 221-232.
11. Haddad, L. (2003). Re-directing Diet Transition. What can Food Policy Do? *Development Policy Review* 21(5-6): 599- 614.
12. Oniango, R.K, Mutuku, J.M. and Malaba, S.J. (2003). Contemporary African food habits and their Nutritional and Health implications. *Asia Pacific Journal of Clinical Nutrition* 12(3): 231-236.
13. Akanbi, W.B. (2002). Growth, Nutrient uptake and yield of maize and okra as influenced by compost and nitrogen fertilizer under different cropping systems. Ph.D. Thesis, Department of Crop Protection and Environmental Biology. University of Ibadan. Pp. 232.
14. Babajide, P.A., Olabode, O.S., Akanbi, W.B., Olatunji, O.O. and Ewetola, E.A. (2008). Influence of composed Tithonia biomass and N-mineral fertilization on soil physio- chemical properties and performance of tomato (*Lycopersicum lycopersicum*) *Research Journal of Agronomy* 2(4): 101-106.
15. Ajilore, O.D**.** (2008). Effects of continuous cultivation and organic amendments on the growth and performance of *C. argentea* in an oxic paleustauf in south western Nigeria. Unpublished B. Agric. Thesis. Soil Science and farm mechanization Department, Olabisi Onabanjo University, Ago- Iwoye.
16. Law- Ogbomo, K.E. and Ajayi, S.O. (2009). Growth and Yield Performance of *Amaranthus cruentus* influenced by planting density and poultry manureapplication.Not. Bot. Hort. Cluj. 37(1): 195-199.
17. Akanbi, W.B., Olaniran, O.A., Ol;aniyi, J.O., Ojo, M.A. and Sanusi, O.O.(2007). Effects of cassava peel compost and nutritional quality of *Celosia* (*Celosia argentea* L.). *Research Journal of Agronomy* 1(3): 110- 115.
18. Chuckwuka, K.S. and Omotayo, E.O. (2009). Soil fertility restoration potentials of Tithonia green manure and water hyacinth compost on a nutrient depleted soil in south western Nigeria. *Research Journal of Soil Biology* 1(1): 20-30.
19. Yinda, G.S. and Adeoye, G.O. (1994). A comparative study of two compositing methods. Proceedings of 3rd African Soil Science, Society Conference, Ibadan.
20. Adediran, J.A., Taiwo, L.B., Akande, M.O. and Sobulo, R.A. (1999). Comparative effects of organic – based fertilizer and mineral fertilizer on the dry matter yield of maize. Biose Research Communication.

21. Olaniyi, J.O., Adelasoye, K.A. and Jegede, C.O. (2008). Influence of Nitrogen fertilizer on the growth, yield and quality of grain amaranth varieties. *World Journal of Agriculture Sciences* 4(4): 506-513.
22. Weber, J., Karczewska, A., Drozel, J., Licznar, M., Licznar, S. and Jamroz, E. (2007). Agricultural and Ecological aspects of a sandy soil as affected by the application of municipal solid waste composts. *Soil Biol. Biochem.*, 39: 1294-1302.
23. Asgharipour, M.R. (2012). Effects of Vermi compost produced from municipal solid waste on the growth and yield isobgol (Plantago ovate Forsk) and *Cuminum cyminum*). *Journal of Medicinal Plants Research* 6(9): 1612-1618.
24. Oyedeji, S., Animasaun, D.A., Bello, A.A. and Agboola, O.O. (2014). Effect of NPK and Poultry manure on growth, yield and proximate composition of three Amaranths. *Journal of Botany*. Article ID 828750, 6pp.
25. Aladesanwa,, R.D., Adenawoola, A.R. and Olowolafe, R.G.(2001). Effects of Atrazine residue on the growth and development of Celosia (*Celosia argentea*) under screen house conditions in Nigeria. *Crop Protection* 20: 231-234.
26. Schippers, R.R.(2000).African Indigenous Vegetables. An Overview of the cultivated species. Natural Resources Institute/ ACP-Eu Technical Centre ofAgriculture and Rural Co-operation Chatham, UK. 214pp.
27. Olufolaji, O.A. and Ayodele, O.J. (1998). Spacing and cutting height requirements for optimum production of *Celosia argentea*. NIHORT Research Bulleting. No4. 6p.
28. Gill, S., MacLachlan, W., Balge, R., Klick, S. and Dutky, E. (1996). Production of Celosia as cut flower. Fs- 684. University of Maryland and Maryland Cooperative Extension Service.
29. Akinyemi, S.O.S. and Tijani – Eniola, H. (1997). Effects of cassava density on productivity of plantain and cassava intercropping system. Fruits. 50: 17-23.
30. Babajide, P.A. and Olla, N.O. (2014). Performance of Indigenous *Celosia argentea* Variety and Soil Physio- Chemical Properties as Affected by Dual Application of Compost and Single N-mineral Fertilizer in Southern Guinea Savana Vegetation Zone of Nigeria. *Journal of Biology, Agriculture and Healthcare* 4(19): 69-74.
31. Grubben, G.J.H. and Denton, O.A. (2004). Plant Resources of Tropical Africa 2: Vegetable, PROTA Foundation, Wageningen, Netherlands/ Backhuys Publishers, Leiden, Netherlands/ CTA, Wageningen, Netherlands
32. Koh, H.L., Chhua, T.K. and Tan, C.H.(2009). A Guide to Medicinal Plant: An Illustrated Scientific and Medicinal Approach, World Scientific. Singapore Pg 292.
33. Aruna, G.A. (2009). Influence of composed Tithonia biomass and N- mineral Performance of *Celosia argentea*. B. Tech. Project, Department of Agronomy, Ladoke Akintola University of Technology, Ogbomosho, Nigeria. 40pp.
34. Wu, S.C., Cao, Z.H., Li, Z.G., Chevng, K.C. and Wong, M.H. (2005). Effect of bio-fertilizer containing- fertilizer, P and K solubilizers and Am fungi on maize growth: a greenhouse trials society Direct- Geoderma 125(1-2): 155-166.
35. Fallah, S.A., Ghalavand, A. And Khajehpour, M.R. (2007). Effects of animal manure incorporation methods and its Inter\gration with Chemical fertilizer on yield and Yield components of maize (*Zea mays* L.) in Khorramabad, Lorestan, JWSS- Isfahan University of Technology 11(40): 233-243.
36. Akinfasoye, J.A.D., Ogunniyan, D.T., Akanbi, W.B. and Olufolaji, A.O. (2008). Effects of organic fertilizer and spacing on growth and yield of Lagos spinach (*Celosia argentea* L.). *Journal of Agriculture and Social Research* 8(1): 70-77.
37. Zhang, J., Blackmer, A.M., Kyveryga, M. 2010. Fertilizer bands and dual effects of Nitrogen on young corn plants *Better Crops*. 94: 17-19.
38. Olaniyi, J.O. and Ojetayo, A.E. (2012). Effects of Nitrogen on growth, yield, nutrient uptake and quality of *Celosia argentea* varieties. *Journal of Agriculture and Biological Sciences* (1): 227-231.
39. Olaniyi, J.O., Adelasoye, K.A. and Jegede, C.O. (2008). Influence of Nitrogen fertilizer on the growth, yield and quality of grain amaranth varieties. *World Journal of Agriculture Sciences* 4(4): 506-513.
40. Aliyu, D. Olanrewaju, J.D.(1996).Response of pepper to fertilizers. Nutrient concentration and uptake as affected by nitrogen and phosphorus level. In: Proc. 14th Horton Conference, Ago-1woye, 1-4 April, 1996.

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