Journal of Agriculture and Environment Vol. 7 No. 1, June 2011: 23-30
ISSN 1595465X

INFLUENCE OF *Jatropha curcas* L. SEED CAKE, POULTRY DROPPINGS AND NPK FERTILIZER ON THE GROWTH AND NUTRIENT COMPOSITION OF BUSH OKRA (*Corchorus olitorious* L.) IN NORTH-WESTERN NIGERIA

A. A. Aliero[1], I. Muhammad[1] and S. S. Noma[2]

[1]Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto, Nigeria.
[2]Department of Soil Science, Usmanu Danfodiyo University, Sokoto, Nigeria.

ABSTRACT

The influence of *Jatropha curcas* seed cake, poultry droppings and NPK fertilizer on the growth and nutrient composition of *Corchorus olitorious* was investigated. Sandy soil samples were homogenized with *Jatropha* seed cake, poultry droppings and NPK fertilizer at 1, 2, 4 and 8 g/bag each in a randomized complete block design consisting of three fertilizer types at four levels each and replicated three times. Growth parameters were evaluated progressively from two weeks after planting (WAP) to harvest. Proximate and mineral compositions of *C. olitorious* were evaluated using standard analytical methods. Application of Jatropha seed cake, poultry droppings and NPK fertilizer significantly ($p < 0.05$) increased plant height, number of leaves, length and breadth of leaves. The number of branches was comparatively higher at 4 g/bag in treatment with Jatropha seed cake and NPK fertilizer. Similarly, the number of flowers was significantly ($p < 0.05$) affected with the application of Jatropha seed cake and NPK fertilizer at 4 g/bag each with 31.7 and 23.0 flowers, respectively. Fertilizer types significantly ($p < 0.05$) affected ash, lipid, moisture and fibre content of the plants compared with the control. The crude protein content decreased with increase in the concentrations of fertilizers. The results of this study suggest the potential of Jatropha seed cake as source of organic fertilizer which is comparable to poultry droppings and NPK fertilizer in supporting the growth of *C. olitorious.*

Key words: *Jatropha* seed cake; *Corchorus olitorious;* Growth and nutrient composition

INTRODUCTION

The use of inorganic fertilizer alone has not been very helpful under intensive agriculture, because it aggravates soil degradation (Sharma and Mittra, 1991). The degradation is brought about by loss of organic matter which consequently results in soil acidity, nutrient imbalance and low crop yield. Response of crop to applied fertilizer depends on soil organic matter. The quantity of soil organic matter depends on the quantity

of organic material which can be introduced to the soil either naturally through returns on root, stubble, slought-off root nodules and root exudates, or artificially via application in the form of organic manure which is called organic fertilizer (Agboola and Omueti, 1982). Nutrients contained in organic fertilizers are released more slowly and are stored for a long time in the soil, thereby ensuring a long residual effect (Sharma and Mittra, 1991). Improvement of environmental condition and public health, as well as the need to reduce cost of fertilizing crops, are also important reasons for advocating increased use of organic materials (Seifritz, 1982; Arisha and Bradisi, 1999). Organic manure can serve as alternative to mineral fertilizers (Gupta *et al*., 1988; Wong *et al*., 1999; Naeem *et al*., 2006) for improving soil structure (Bin, 1983; Dauda *et al*., 2008) and microbial biomass (Belay *et al.,* 2001; Suresh *et al*., 2004).

In Nigeria, *Corchorus olitorius* is a popular species cultivated as a leafy vegetable and as an important source of fiber (Morakinyo, 1997; Amin and Shahjahan, 1999). Medicinally, the leaves and seeds are used in the treatment of chronic cystitis, gonorrhea, dysuria, toothache and peptic ulcer (Noumi and Dibakto, 2000), and as laxative and blood purifier (Ayodele, 2005). A cold infusion is used as a tonic to restore appetite and strength (Sharaf and Negm, 2005). The leaves have also been found to suppress elevation of postprandial blood glucose levels in rats and humans (Innami *et al*., 2005). In recent times, there is great awareness on the consumption of organically grown produce, rather than conventional or industrial produce which are grown using pesticides, herbicides, synthetic fertilizers, and other chemicals that are toxic to the human body. The use of *Jatropha* seed cake as a source of fertilizer and in water purification had been reviewed (Annon, 2000). Despite these, the potential of *Jatropha* seed cake for use as organic fertilizer for growth of plants has not been investigated. This study compared the effect of *Jatropha* seed cake, poultry droppings and NPK fertilizer on the growth and nutrient composition of *Corchorus olitorious*.

MATERIALS AND METHODS

Experimental Set-up

The experiment was carried out in 2010 rainy season at the Biological Sciences Garden of the Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto. Soil sample was collected from the Biological garden after the bushes were cleared from the experimental site. The seeds of *Corchorus olitorious* and *Jatropha curcas* were obtained from the Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto. NPK fertilizer, poultry droppings were also obtained from SG Adiya Farm located along Sokoto-Birnin-Kebbi road in Sokoto, and the polythene bags used for growth evaluation were obtained from Sokoto State afforestation program. Soil samples measuring 1.4 kg/bag were thoroughly mixed with *Jatropha curcas* seed cake, NPK fertilizer and poultry droppings at 1, 2, 4 and 8 g/bag each. The experiment was laid down in a randomized complete block design consisting of three fertilizer treatment with four levels. and replicated three times. A control was also set up without any of the treatments. The polythene bags were ¾ filled with homogenized sandy soil (sand 91.96%, silt 4.71% and 3.33%) and watered to 80% capacity. The seedlings were transplanted 3 weeks after sowing with three stands per bag and later thinned to one.

Data Collection

Data collection commenced from 4 weeks after transplanting (WAT) and measurements of plant height, length and breadth of the leaves were carried out at 4, 6 and 8 WAT. The number of leaves, flowers and branches of each plant were counted. The plants were harvested at 9 WAT. The roots and shoots were separated carefully and their fresh weight determined.

Proximate and Mineral Analysis

The plant materials were oven-dried at 70^0C for 72 hours and weight determined. The proximate composition of the shoots was determined as described by Tell and Hagarty (1984). Ash determination involved the incineration of the samples in a snuffle furnace at 600ºC for 3 hours. The mineral contents of the leaf samples were measured in a digest obtained by treating each sample with a mixture of hydrogen peroxide, sulphuric acid, selenium and salicyclic acid. The total N content in the digest was determined by micro Kjeldahl method as total Kjeldahl nitrogen (TKN). The crude protein was obtained by multiplying TKN values by a conversion factor of 6.25 (AOAC, 2006). Crude lipid was determined by extracting the sample with n-hexane in a Soxhlet extractor, while crude fibre was estimated from the loss in weight on ignition of dried residue following digestion of fat free samples. Determinations were done in triplicates and results expressed as averages of percentage values on dry weight basis. The digests were analysed for total P, Na, Ca and Mg. Total phosphorous was determined as phosphate using the phosphor-vernadomolybdate procedure, while Ca and Mg by titration method using Ethylene Diamine Tetra acetic acid (EDTA) solution, and Na and K by flame photometry and the absorbance measured at 880 nm.

Data Analysis

Data obtained were analysed using two-way analysis of variance in MINITAB version 13, and significant means were separated using Duncan's Multiple Range Test (DMRT) at $p< 0.05$ (Steel and Torrie, 1996).

RESULTS AND DISCUSSION

Growth and Biomass Accumulation

Table 1 shows the mean values for the growth parameters and biomass accumulation of *C. olitorious* at harvest. Application of Jatropha seed cake, poultry droppings and NPK fertilizer significantly ($P<0.05$) increased plant height, number of leaves, length and breadth of leaves as compared with control. The number of branches was comparatively higher at 4 g/bag in treatment with Jatropha seed cake and NPK fertilizer with 26. 3 and 23 branches respectively. Similarly, the number of flowers were significantly ($P<0.05$) affected with the application of Jatropha seed cake and NPK fertilizer at 4 g/bag with 31.7 and 23.0 flowers, respectively. From the results of this study, 8 g/bag of Jatropha seed cake and NPK fertilizer decreased number of flowers, and days to flower appearance was observed earlier as compared to control that did not produce any flower at harvest (12 WAT).

Table 1: Effect of fertilizer type on growth and biomass accumulation of *Corchorus olitorious* plant at harvest.

Fertilizer type	Conc. (g/pot)	Plant height (cm)	Number of leaves	Length of leaves (cm)	Breadth of the leaves (cm)	Number of branches
Jatropha seed cake	0	56.3 ^{d}	89.7 ^{d}	6.17 ^{d}	5.00 ^{e}	16.3 ^{b}
	1	60.0 ^{c}	200.6 ^{b}	8.70 ^{a}	6.03^{a}	25.6^{a}
	2	63.0 ^{a}	185.7 ^{b}	7.90 ^{b}	6.00^{b}	24.3^{a}
	4	60.3^{c}	188.7 ^{b}	7.67 ^{c}	5.67^{c}	26.3^{a}
	8	61.0 ^{b}	148.3^{c}	7.67^{c}	5.33^{d}	25.7^{a}
	SE ±	0.12	0.59	0.17	0.10	0.81
Poultry droppings	0	56.33 ^{b}	89.7 ^{d}	6.17 ^{c}	5.00	16.3 ^{e}
	1	55.3 ^{c}	94.7 ^{d}	7.67^{a}	5.00	19.0 ^{c}
	2	49.7 ^{e}	106.3 ^{d}	6.57 ^{b}	4.33	18.3 ^{c}
	4	50.0 ^{d}	101.7 ^{d}	6.17^{c}	4.00	23.0 ^{b}
	8	59.0^{a}	140.3 ^{c}	6.57^{b}	4.33	27.6^{a}
	SE ±	0.12	0.41	0.19	0.95	0.56
NPK	0	56.3^{e}	89.7 ^{d}	6.17 ^{d}	5.00	16.3^{c}
	1	68.0 ^{b}	304.0 ^{a}	8.83^{a}	6.50	11.3^{d}
	2	67.3 ^{c}	192.7 ^{b}	8.43 ^{b}	6.16	20.3^{b}
	4	72.0^{a}	168.7 ^{c}	7.33 ^{c}	5.33	23.0^{a}
	8	64.0^{d}	136.3^{c}	7.33 ^{c}	4.50	20.3^{b}
	SE ±	0.14	0.41	0.16	0.11	0.36

	Conc. (g/pot)	Number of flowers	Shoot fresh weight (g)	Root fresh weight (g)	Shoot dry weight (g)	Root dry weight (g)
Jatropha seed cake	0	-	43.5^{b}	11.07^{a}	8.37^{b}	3.39
	1	17.0^{c}	35.8^{d}	9.20^{b}	5.10^{d}	3.11
	2	29.0^{b}	34.6^{e}	8.49^{c}	7.26^{c}	3.05
	4	31.7^{a}	38.4^{c}	5.56^{d}	4.85^{e}	2.00
	8	9.67^{d}	46.6^{a}	8.02^{c}	9.86^{a}	2.78
	SE ±	0.86	0.14	0.18	0.19	0.77
Poultry droppings	0	-	43.5^{c}	11.07^{b}	8.37^{d}	3.39^{d}
	1	-	93.7^{a}	13.64^{a}	16.46^{a}	4.52^{b}
	2	8.33^{b}	88.3^{b}	13.56^{a}	16.23^{a}	5.12^{a}
	4	5.00^{c}	77.4^{c}	9.77^{c}	13.97^{b}	3.71^{c}
	8	14.3^{a}	57.1^{c}	9.16^{c}	10.36 ^{c}	3.23^{d}
	SE ±	0.32	0.27	0.28	0.28	0.10
NPK	0	-	43.5^{e}	11.07^{c}	8.37^{e}	3.39^{c}
	1	30.7^{a}	217.2^{a}	29.04^{a}	36.75^{a}	9.29^{a}
	2	8.33^{d}	90.4^{c}	14.49^{b}	18.63^{b}	4.85^{b}
	4	18.0^{b}	102.2^{b}	14.17^{b}	17.80^{c}	5.19^{b}
	8	10.0^{c}	47.8^{d}	7.08^{d}	9.37^{d}	2.81^{c}
	SE ±	0.80	0.18	0.56	0.59	0.78

Means in a column followed by same letter within a treatment group are not significantly different ($p > 0.05$).

The increased number of flowers with the application of fertilizer agrees with the findings of Latchwell and Evans (1951) that observed increased flower and pod formation in soybeans. This result is similar to those obtained by Blatt (1991) and Ouda and Mahadeen (2008) on broccoli, Bjelic and Stankovic (2000) and Al-Nasir (2002) on cauliflower (*B. oleracea* var. *Botrytis*) that showed early flowering with the application of fertilizer on the studied plants.

Shoot biomass significantly ($p< 0.05$) increased with the application of Jatropha seed cake at 8 g/bag while poultry droppings and NPK fertilizer at same concentration decreased shoot biomass (Table 1). A similar result was obtained for the root biomass in all the treatments evaluated which differed significantly ($p< 0.05$) from the control. The observed decrease in growth of *C. olitorius* with the application of 8 g/bag of NPK fertilizer is similar to the earlier reports of Shiralipour and Faber (1996) on Broccoli (*B. oleracea* Italica) and Magnusson (2002) on Chinesis cabbage (*B. chinesis*) who recorded decreased growth of the plants with the application of NPK fertilizer. Organic fertilizer is known to activate many species of living organisms which release phytohormones and may stimulate plant growth and absorption of nutrients (Arisha *et al*., 2003). This may be case with the application of Jatropha seed cake and poultry droppings on the growth of *C. olitorius* (Table 1). The beneficial effect of organic manure on crop yield may be due to an increase in organic matter rate caused by the generation of carbon dioxide during compost decomposition (Wilkinson, 1979).

Proximate and Mineral Composition

Table 2 shows the effect of fertilizer type on proximate composition of *C. olitorious* leaves. The fertilizer types significantly ($p< 0.05$) affected ash, lipid, nitrogen, moisture and fibre content of the plants compared with the control. Low level of moisture is desirable in food stuff because high moisture content causes caking of flours and deterioration of powdered food items (Pearson, 1973). The crude protein content decreased with increase in the concentrations of fertilizers. The effect of fertilizer on mineral composition of *C. olitorius* is depicted in Table 3. Application of the fertilizer types did not yield a significant positive effect on the elemental composition evaluated. Fertilizer types decreased magnesium content and Jatropha seed cake and poultry droppings also decreased ash content. Although, high ash content is an indication of significant presence of mineral element (Sallau *et al.*, 1999), in this study a significant decrease in ash content was observed. In this study, potassium had the highest values while sodium recorded the least values in both treatments.

CONCLUSION

The results of this study suggest the potential of Jatropha seed cake as source of organic fertilizer which is comparable to poultry droppings in supporting the growth of *C. olitorious.* However, at 8 g/bag each of poultry droppings and NPK fertilizer, plant growth decreased. The result of this study reinforces the need for the selection of appropriate concentration of fertilizers for improving the growth of C. *olitorious.*

Table 2: Effect of fertilizer types on the proximate composition of *C. olitorious* leaves (%).

Fertilizer types	Conc. (g/pot)	Ash	Lipid	Fibre	Crude protein	Moisture
Jatropha seed	0	21.5[a]	3.00[b]	9.00[c]	7.96	6.50[b]
Cake	1	13.0[d]	2.50[c]	10.0[b]	7.18	5.50[c]
	2	15.0[c]	3.00[b]	10.8[a]	6.21	6.50[b]
	4	16.5[b]	3.00[b]	11.5[a]	6.30	5.50[c]
	8	15.0[c]	3.50[a]	9.00[c]	6.30	7.00[b]
	SE ±	0.34	0.63	0.28	0.32	0.13
Poultry	0	21.5	3.00	9.0[b]	7.96	6.50
droppings	1	19.0	3.00	8.5[c]	4.70	6.00
	2	16.5	3.00	10.0[a]	5.08	6.50
	4	17.5	3.50	9.5[b]	6.56	6.00
	8	20.5	3.00	8.5[c]	7.00	6.50
	SE ±	0.40	0.65	0.19	0.22	0.22
NPK	0	21.5	3.00	9.00	7.96	6.50
	1	21.5	2.50	10.5	7.96	6.00
	2	21.5	3.00	9.00	7.44	7.50
	4	20.5	2.50	13.0	7.35	7.00
	8	17.5	2.00	9.50	7.26	6.50
	SE ±	0.43	0.55	0.21	0.25	0.13

Means in a column followed by same letter within a treatment group are not significantly different (P>0.05).

Table 3: Effect of fertilization types on mineral composition of *C. olitorious*

Treatment	Conc.(g/pot)	Na (mg/kg)	K (mg/kg)	Ca (%)	Mg (%)
Jatropha	0	180[a]	19. 25[a]	0.035	0.21
seed cake	1	120[b]	17.00[c]	0.030	0.17
	2	108[d]	16.00[d]	0.025	0.17
	4	115[c]	17.50[b]	0.050	0.21
	8	120[b]	15.50[e]	0.045	0.20
	SE ±	0.27	0.36	0.13	0.61
Poultry	0	180[b]	19.25[a]	0.035	0.216
droppings	1	145[d]	13.75[e]	0.040	0.185
	2	120[e]	15.75[d]	0.045	0.195
	4	147.5[c]	17.25[c]	0.030	0.190
	8	182.5[a]	17.75[b]	0.040	0.195
	SE ±	0.33a	0.36	0.99	0.36
NPK	0	180[a]	19.25[a]	0.035	0.216
	1	175[b]	19.00[b]	0.040	0.175
	2	150[c]	19.25[a]	0.030	0.165
	4	150[c]	17.75[c]	0.025	0.165
	8	140[d]	15.00[c]	0.035	0.155
	SE ±	0.34	0.38	0.99	0.19

Means in a column followed by same letter within a treatment group are not significantly different (P>0.05).

REFERENCES

Agboola, J. and K. E. Omueti (1982). Effect of organic and inorganic fertilizer on growth of Cassava. *Australian Journal of Basic and Applied Sciences,* 1 (3): 187-192.

Al-Nasir, F. (2002). Effect of organic fertilizers on yield and nutrients concentration of cauliflower plant. *Archiv Fuer Acker und Pflanzenbau und Bodenkunde-Archives of Agronomy and Soil Science,* 48: 37–47.

Amin, M. N. and M. Shahjahan (1999). Production of cellulose acetate from jute sticks. *Pakistan Journal of Scientific and Industrial Research,* 42(6): 377-379.

Anonymous (2000). *Horticulture in Malawi.* Horticulture Development Organisation of Malawi, German Project Promotion of Horticulture. Lilongwe, Malawi.

AOAC (2006). *Official Methods of Analysis.* Association of Official Analytical Chemists (18th ed.). Arlington, Virginia. 980.03 (3.2.02).

Arisha, H. M, A. A. Gad and S. E. Younes (2003). Response of some peppers cultivars to organic and mineral nitrogen fertilizer under sandy soil conditions. *Zagazig Journal of Agricultural Research,* 30: 1875-99.

Arisha, H. M. and A. Bradisi (1999). Effect of mineral fertilizers and organic fertilizers on growth, yield and quality of potato under sandy soil conditions. *Zagazig Journal of Agricultural Research*, 26: 391–405.

Ayodele, A. E. (2005). The medicinally important leafy vegetables of South Western Nigeria. Ethobotanical leaflets. 1: 16. Available at http:/www. siu.edu /~ebl/ leaflets / ayodele.htm. Assessed on 13th December, 2010.

Belay, R. F., Mader, C. K. F. Andreas and D. David (2001). Soil fertility and biodiversity in organic farming. *Science*, 296 (5573):1694-1697.

Bin, J. (1983). Utilization of green manure for raising soil fertility in China. *Soil Science*, 135: 65–69

Bjelic, V. N. and L. N. Stankovic (2000). Effect of manuring on cauliflower development and yield. *Acta Horticulturae*, 533: 397–398.

Blatt, C. R. (1991). Comparison of several organic amendments with a chemical fertilizer for vegetable production. *Scientia Horticulturae*, 47: 177–189.

Dauda, S. N., F. A. Ajayi and E. Ndor (2008). Growth and yield of water melon (*Citrullus lanatus*) as affected by poultry manure application. *Journal of Agricultural Science Society*, 4: 121–124.

Gupta, A. P., S. R. Antil and P. R. Narwal (1988). Effect of farmyard manure on organic carbon, available N and P contents of soil during different periods of wheat growth. *Journal of Indian Soil Science*, 36: 269–73.

Innami, S., H. Ishida, K. Nakamura, M. Kondo, K. Tabata, A. Koguchi, J. Shimizu and T. Furusho (2005). Jew's mellow leaves (*Corchorus olitorius*) suppress elevation of postprandial blood glucose levels in rats and humans. *International Journal of Vitamin and Nutrition Research,* 75(1): 39-46.

Latchwell, D. J, and C. E. Evans (1951). Nitrogen uptake from solution by soya bean at successive stages of growth. *Agronomy Journal*, 43: 264 – 270.

Magnusson, M. (2002). Mineral fertilizers and green mulch in Chinese cabbage (*Brassica pekinensis* Rupr): effect on nutrient uptake, yield and internal tipburn. *Soil and Plant Science*, 52: 25–35.

Morakinyo, J. A. (1997). Morphology and cytogenetics of *Corchorus olitorius* and *C. tridens. Bioscience Research Communication*, 9: 9-13.

Naeem, M., J. Iqbal and M. A. A. Bakhsh (2006). Comparative study of inorganic fertilizers and organic manures on yield and yield components of Mungbean (*Vigna radiata* L.). *Journal of Agricultural Science Society*, 2: 227–9

Noumi, E. and T. W. Dibakto (2000). Medicinal plants used for peptic ulcer in the Bangangte Region, Western Cameroon. *Fitoterapia*, 71(4): 406-412.

Ouda, B. A. and A.Y. Mahadeen (2008). Effect of fertilizers on growth, yield, yield components, quality and certain nutrient contents in broccoli (*Brassica oleracea*). *International Journal of Agricultural Biology*, 10: 627–32

Pearson, D. (1973). *Laboratory Techniques in Food Analysis.* Butterworth Publishers, London.

Roe, E. N. and C. G. Conforth (2000). Effect of dairy lot scraping and composted dairy manure on growth, yield and propit potential of double cropping vegetables. *Science and Utilization*, 8: 320-327.

Sallau, M. S., J. N. Akanye and H. O. Akanye (1999). The nutrient composition of the seed of *Tetracarpidium conophorum* (Asala). *West African Journal of Biological Sciences*, 9: 50-55.

Seifritz, K. L. (1982). Long term organic farming fosters below and above ground biota implication for soil quality, biological control and productivity. *Soil Biology and Biochemistry*, 40 (9): 2297-2308.

Sharaf, A. and S. A. R. Negm (2005). Pharmacological study of *Corchorus olitorius* L., seeds with special reference to its cardiovascular activity. *Plant Foods for Human Nutrition*, 17(4): 305-312.

Sharma, A. and K. S. Mittra (1991). Complementary organic and inorganic fertilizer application. *Autralian Journal of Basic and Applied Science*, 1(3): 187-192.

Shiralipour, A. and B. Faber (1996). Greenhouse broccoli and lettuce growth using composted bioslids. *Compost Science and Utilization*, 4: 38–44.

Steel, R. G. D. and J. H. Torrie (1996). *Principles and Procedures of Statistics*. Mc Graw-Hill, New York, U.S.A. p.481.

Suresh, K. D., G. Sneh, K. K. Krishn and C. M. Mool (2004). Microbial biomass carbon and microbial activities of soils receiving chemical fertilizers and organic amendments. *Archives of Agronomy and Soil Science*, 50: 641–7.

Tell, D. and M. Hagarty (1984) *Soil and Plant Analysis*. International Institute of Tropical Agriculture, Ibadan, Nigeria.

Wilkinson, S. R. (1979). Plant nutrient and economic value of animal manure. *Journal of Animal Science*, 48:121-33.

Wong, J. W. C., K. K. Ma, K. M. Fang and C. Cheung (1999). Utilization of manure compost for organic farming in Hong Kong. *BioResource Technol*ogy, 67: 43–6.