Journal of Applied Biosciences (2008), Vol. 7: 202 – 206.
ISSN 1997 – 5902*: *www.biosciences.elewa.org

Effect of nitrogen released from rumen digesta and cow dung on soil and leaf nutrient content of Gboma (*Solanum macrocarpon* L.)

AWODUN M. A.
Department of Crop, Soil and Pest Management, Federal University of Technology, PMB 704, Akure, Nigeria

Corresponding author email: m_awodun@yahoo.com

Abstract
Objective: To study the effect of rumen digesta and cow dung as sources of nutrients for Gboma (*Solanum macrocarpon* L).
Methodology and results: Experiments were conducted in the screenhouse in which five levels of rumen digesta and cow dung (0, 2, 4, 6 and 8 ton ha^{-1}) were applied to Gboma seedlings. The amount of nitrogen released into the soil from cow dung was 13.4% higher than that released from rumen digesta while phosphorous released by rumen digesta was 21% more than that of cowdung. Cowdung increased leaf N, P, K, Ca and Mg contents, with a rate dependent effect. Compared to rumen digesta, cow dung at all levels resulted into higher values of plant height (3.9%), total biomass (8.9%), root weight (20.9%), shoot weight (10.1%), leaf weight (5.8%), leaf width (3.7%) and plant area (1.9%).
Conclusion and application of findings: Cow dung releases more nitrogen into the soil than rumen digesta, but both manures can be used to grow vegetables. Application of 6 ton ha-^{1} of cow dung would give optimum yield but higher rates iwould be required for rumen digesta.

Key words: Cow dung, rumen digesta, *Solanum macrocarpon*, soil, leaf nutrient content.

Citation: Awodun MA, 2008. Effect of nitrogen released from rumen digesta and cow dung on soil and leaf nutrient content of Gboma (*Solanum macrocarpon* L.). *Journal of Applied Biosciences* 7: 202 – 206.

INTRODUCTION
Managing cowdung and animal wastes (rumen digesta) from abattoirs is a common problem in developing countries such as Nigeria. Putting these wastes into effective agrarian use is also often a problem because they are bulky, low-grade fertilizers of variable composition and frequently have high water content thus not easy to transport far from point of source. On-farm management problems and associated offensive odors further complicate their use (Stevenson & Cole, 1999). These wastes could however be used to alleviate soil nutrient depletion problems, which is one of the most important constraints to crop productivity in sub-Saharan Africa (Schoberg *et al.,* 2000). It is already documented that the current use of fertilizers in Africa is well below the recommended rates,

partly due to prohibitive cost, limited availability and lack of knowledge on appropriate and efficient application.

Worldwide, interest in the use of organic materials as sources of nutrients in vegetable production has increased (Chikwuyu *et al.,* 2002). Organic materials are valuable nutrient resources for all types of crops, fruit and vegetables (Chikwuyu *et al.,* 2002). Good sources of organic fertilizers include animal wastes, wood-ash, rice husks, mills and brewery wastes, sawdust and other crop wastes (Awodun, 2007).

Rumen digesta are wastes from abattoirs that are presently a menace in most urban cities of developing countries. The use of these wastes as plant nutrient sources has not received much research attention in Nigeria. Other uses of rumen digesta from cattle, sheep and goat could be in replacing maize and/or whole wheat in monogastirc diets (Rojugbokan *et al.,* 2006).

This study was carried out to compare nutrient release rates from rumen digesta and cattle dung after incorporation into the soil and their effects on leaf nutrient content of gboma (*Solanum macrocarpon* L).

Materials and Methods

Experiments were conducted between January to June, 2007 using potted plants in the screen house at the Federal University of Technology, Akure ($7^0$5'N; $5^0$47'E) in the rainforest zone of Southwest Nigeria.. The screen house was made of nylon net on the sides and roof and had mean daily temperature of 28°C.

Top soil collected from the field was put into black nursery polythene bags with holes at the base. Seeds of the improved *S. macrocarpon* variety Gboma were bought from the State Agricultural Development Programme (ADP), and first raised in the pre-nursery beds then transplanted into the nursery pots after two weeks. Air-dried, ground cowdung and rumen digesta were applied separately by ring method to each plant two weeks after transplanting at 0, 2, 4, 6 and 8 ton ha^{-1}. The treatments were replicated three times and arranged in randomized complete block design. Eight plants were selected from each treatment for determination of leaf nutrient content.

Soil analysis: Soils were analyzed before the commencement of the experiments and also eight weeks after treatment application. Samples were air-dried and sieved using a 2 mm gauge sieve, after which the sandy clay loam sorts were analyzed as described by Carter (1993). Soil organic matter (SOM) was determined by wet dichromate oxidation method, total N by micro-kjeldahl method and available P by molybdenum blue colorimetry after bray-1-extraction. Exchangeable cations were extracted with ammonium acetate. K was determined on flame photometer and Ca and Mg by EDTA titration. Soil pH was determined in 1:1 soil-water suspension (Tel & Hagarty, 1984).

Cowdung and rumen digesta analysis: Samples of air-dried cowdung and rumen digesta were oven-dried at 70°C for 24 hours and milled for analysis. Nitrogen was determined using micro-Kjeldahl method. Samples were dried and ashed using nitri-perchloric sulphuric acid mixture for determination of P, K, Ca and Mg. Phosphorus was determined using vanado molybdate colorimetry, K by flame photometer and Ca and Mg by EDTA titration (Tel & Hargarty, 1984).

Leaf analysis: At 8 weeks after application of treatments leaf samples were collected, oven dried at 70°C for 24 hours and milled. Nitrogen was determined using micro-kjeldahl methods. Samples were dried, ashed using nitric-perchloric-sulphuric acid mixture for determination of P, K, Ca and Mg as described above.

Statistical analysis: Data were subjected to analysis of variance and means separated using the Least Significant Difference (LSD) test at 5% level of probability.

RESULTS AND DISCUSSION

The experimental soils were sandy clay, containing 57.1 % sand 38.28 % clay and 4.62% silt. Comparatively, the soil had about the same P content initially, but less Ca and Mg, than the cow dung and the rumen digesta (Table 1).

Compared with the control, cowdung applied at 8 ton ha^{-1} resulted in the highest nitrogen content in Gboma leaves (Table 2). Nitrogen content was higher in leaves of plants treated with cowdung than those treated with rumen digesta. Results further showed that nutrient uptake, especially Mg, P, and K were significantly higher (P>0.05) when manure was applied at 2 ton ha^{-1}. When compared with other treatments Phosphorous uptake by crop is affected by various factors (David, 2004). P transformations, fixations and changes into other forms in the soil that are not readily available to the plant is a major challenge (Resende *et al.*, 2006). This might explain why a higher content of phosphorous in the rumen digesta is not reflected in its uptake by plants. Efficient addition of phosphatic fertilizers to soils in the tropics remains a challenge, particularly in long-term soil management (Resende *et al.*, 2007).

After treating soil with cow dung or rumen digesta, more nutrients were released into the soil (Table 3). Cow dung had more residual nutrient after planting than rumen digesta.This is consistent with expectations since decomposition of rumen digesta is slower than for cowdung (Moyinjesu & Atoyosoye, 2002).

Table 1: Initial chemical analysis of soil, cowdung and rumen digesta.

Parameter	Cow dung	Rumen Digesta	Topsoil
Nitrogen	1.69*	1.29	0.12
Phosphorus	23.02**	35.31	31.11
Calcium	1413.10	719.40	6.40
Magnesium	926.12	345.3	3.10
pH	-	-	7.74

* = %; ** = mg/kg

Table 2: Analysis of leaf nutrient content after treating plants with cow dung or rumen digesta.

Treatment	Cowdung					
	P(mg/kg)	N (%)	Ca (mg/kg)	Mg (mg/kg)	Na (mg/kg)	K (mg/kg)
T_1	2901.89	3.09	3502.63	420.32	11383.54	37653.24
T_2	8838.85	3.39	3474.90	1621.62	9073.36	38416.99
T_3	6478.11	3.25	3083.39	840.93	700.77	3223.55
T_4	6283.20	3.75	2245.61	842.11	7578.95	29754.39
T_5	3575.19	3.85	3731.98	203.56	10347.75	38846.48
	Rumen digesta					
T_1	3545.49	1.87	2584.81	1163.17	10985.46	38126.01
T_2	7028.66	2.54	2816.90	938.97	12050.08	36131.93
T_3	4373.36	2.60	12389.38	2123.89	12389.38	9536.08
T_4	5515.02	2.65	3891.60	500.35	10701.88	73446.33
T_5	2877.08	2.72	2850.00	1520.19	11084.72	743049.33

Treatments T1 – T5 represent manure applications at 0, 2, 4, 6 and 8 ton /ha.

Table 3: Chemical analysis of soil after treatment with cow dung or rumen digesta.

Treatment	Cow dung					
	pH	P Mg/kg	K cmol/kg	Ca cmol/kg	Mg cmol/kg	Na cmol/kg
T_1	6.80	1.0	6.15	2.92	0.46	0.14
T_2	6.60	1.2	6.67	4.80	1.15	0.23
T_3	6.90	1.3	5.64	5.60	1.96	0.20
T_4	6.67	3.2	5.13	6.56	1.79	0.65
T_5	6.73	3.2	7.17	5.28	1.80	0.40
	Rumen digesta					
T_1	5.97	1.0	3.08	2.68	0.28	0.44
T_2	7.24	1.4	3.59	3.12	0.35	0.32
T_3	7.05	1.6	6.67	5.7	0.17	0.33
T_4	6.90	2.4	4.62	7.6	0.35	0.26
T_5	6.88	2.8	6.15	5.9	1.21	0.24

Treatments T1 – T5 represent manure applications at 0, 2, 4, 6 and 8 ton /ha.

Rumen digesta has higher C/N ratio than cowdung and thus more nutrients would be expected to be released into the soil from cowdung (Odedina *et al*., 2007). The higher nutrient uptake in leaves of plants treated with cowdung might be due to faster release of nutrients from this type of manure. Rumen digesta decomposes more slowly and thus would release less nutrients during the short period of gboma growth in the field (Moyinjesu & Atoyosoye, 2002). The better growth of gboma vegetable after treatment with cow dung (Table 4) might be due to longer retention of nutrients against leaching.

In the past 50years, increased use of N fertilizers and better management were the major contributors to large increases in global food productions (Smil, 2004). However, nitrogen fertilizers contribute substantially to production cost of crops and thus may not be possible to apply as required (Malvancy *et al*., 2006). Looking inwards into locally available and affordable cheap source of nitrogen would therefore be appropriate to ensure sustainable production. On the overall our findings show that cowdung is better, but not significantly superior to rumen digesta in improving soil fertility. Thus either of the two organic wastes could be used to improve soils. To validate the findings of this screenhouse based study, it is recommended that field based experiments be carried out. Since vegetable production in cities is usually done on small pieces of land, and repeatedly over several years, the fertility of such land could be improved through use of organic wastes such as rumen digesta or dung wastes.

Table 4: Effect of applying cow dung or rumen digesta on yield and plant growth parameters of Gboma.

Treatment	Cow dung								
	Plant Height	Total Biomass	Root Weight	Shoot Weight	Leaf Weight	Stem Weight	Leaf Length	Leaf Width	Plant Area
T_1	54.00	79.83	16.17	83.67	64.33	26.33	24.33	15.67	170.42
T_2	49.33	71.00	11.33	59.67	38.67	21.00	22.33	15.67	188.32
T_3	43.33	56.83	6.67	50.16	29.50	21.00	21.33	10.67	208.56
T_4	54.33	88.67	9.33	79.33	56.50	28.83	28.50	16.83	200.23
T_5	58.00	83.83	9.00	74.83	46.67	28.50	26.50	16.33	240.32
LSD(0.05)	19.88	42.3	7.0	52.52	26.10	20.22	18.23	4.52	
	Rumen digesta								
T_1	42.00	59.00	4.67	54.67	36.33	18.33	21.17	12.67	170.46
T_2	50.83	57.17	5.33	51.83	28.17	20.33	20.17	13.33	169.27
T_3	39.67	59.83	7.17	52.67	32.33	17.00	22.33	14.67	207.56
T_4	47.67	63.83	7.50	56.33	36.00	20.33	21.83	12.83	180.75
T_5	59.33	78.00	9.67	68.33	39.67	28.67	23.83	16.17	242.28
LSD(0.05)	26.27	55.35	8.14	49.05	27.74	21.22	5.39	4.63	110.09

Treatments T1 – T5 represent manure applications at 0, 2, 4, 6 and 8 ton /ha.

REFERENCES

Awodun MA, 2007. Effect of sawdust ash on nutrient status, growth and yield of cowpea (*Vigna unguiculata* (L) Walp). Afri. Journal of Agricultural Research 1(2): 92-96.

Carter MR, 1993. Soil sampling and methods of analysis. Canadian Society of Soil Science, Laris Publishers, London pp. 823.

Chinkuyu AJ, Kamwar RJ, Larimon JC, Xin Baley TB, 2002. Effects of laying hen manure application rates on water quality. Trans AJAE 45/21: 299-308.

David WD, 2004. Will we run out of phosphorous ?. Better Crops with Plant Food. Vol;88.No.2 p3-5.

Malvancy RL, Khan SA, Ellsworth RR, 2006. Need for soil-based approach in Managing fertilizer for profitable corn production. Soil Sci. Soc. Am. J. 70: 172-182. http:// soil.scijournals.org/contents/vol .70/issue1/

Moyinjesu BI. and Atoyosoye B, 2002. Utilization of agricultural wastes for the growth of leaf and soil chemical composition of cocoa seedlings in the nursery. Partanika. J. Trop. Agric. Sci., 25: 53-62.

Odedina SA, Ojeniyi SO, Awodun MA, 2007. Effect of Agronomical wastes on nutrient status and performance of tomato. GJER, 1(1); 18 -21.

Resende AV, Furtini AE, Alves VM, Curi N, Muniz J, Afaquin V, Kinpara DI, 2007. Phosphate efficiency for corn following brachiaria grass pasture in the Cerrado region (Brazil). Better Crops with plant food. Vol.XCL (91): 19-21.

Rojugbokan OF, Agbede JO, Olowu OPA, 2006. Compositional studies of rumen digesta from cattle, sheep and goat. Proceedings of the 2nd Annual Conference of SAAT, FUT, Akure, Nigeria. 24th May 2006, pp. 122-124.

Smil V, 2001. Enriching the earth: Fritz Haber,Carl Bosch, and the transformation of World food production. The MIT Press, Cambridge, MS . London.

Schoberg J, MCNeal B, Baore KJ, June JN, 2000. Nitrogen stress effects on growth and nitrogen accumulation by field grown tomatoes. Agron J. 92: 152-167.

Tel DA, Hagarty M, 1984. Soil and Plant analysis. Department of Land Resources Science. University of Guelph, Ontario Canada. Pp 277.