

EFFECT OF MINERALIZATION RATES OF COW-DUNG, SHEEP-DROPPING AND MILLET STRAW IN SEMI-ARID SANDY LOAM SOILS OF YOLA, NORTH EASTERN NIGERIA

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Abstract

Mineralization is the conversion of plant nutrients from organic to inorganic forms in recently added organic materials by soil microorganisms. Cow-dung, sheep-dropping and millet straw are some of the organic materials commonly used on sandy loam soils of semi-arid Nigeria. Nutrients released from the added materials depend on the mineralization rates, and the mineralization rates is in turn affected by nature of organic materials, soil and environmental conditions as well as cultural practices. In sandy loam soils of semi-arid regions, soil temperatures may be extremely high, while soil moisture may be scarce to the level that microbial activities are affected and such the rate of nutrients mineralized could not be easily predictable. Pot experiment was conducted from 2011 to 2012 in Soil Science Laboratory Modibbo Adama University of Technology, Yola, Adamawa State, Nigeria. The experiment was with the aim of estimating mineralization rates and release patterns of ammonium ($\text{NH}_4\text{-N}$) and nitrate nitrogen ($\text{NO}_3\text{-N}$) from cow-dung, sheep dropping and millet straw. The experimental design was factorial; where the main factors were cow-dung, sheep dropping and millet straw, while the treatments were 25g (5 tons ha^{-1}), 50g (10 tons ha^{-1}) and 75g (15 tons ha^{-1}) for each of the three organic materials. The mean result from the experiment indicates that there was no significant difference in the mineralization rates among the three organic materials except millet straw. Plotting the graph between incubation period (time) against mineralization rates shows that ammonium nitrate mineralization rates from cow-dung were positive from 4 to 10WAI, (weeks at incubation). While mineralization rates of nitrate nitrogen were positive from 2-10WAI. Highest ammonium and nitrate nitrogen mineralization rates of 3.85 and 1.99% were recorded at 6WAI. For sheep dropping, mineralization rates of ammonium nitrogen were positive from 4 to 10WAI, while that of nitrate nitrogen were positive from 2 to 8, as well as 12WAI. Highest ammonium and nitrate nitrogen mineralization rates of 1.92 and 4.19% were recorded at 6 and 8WAI, respectively. For millet straw, mineralization rates of ammonium and nitrate nitrogen were negative throughout the period of incubation (12 weeks). Highest mineralization rates of ammonium and nitrate nitrogen were recorded from cow-dung and sheep dropping respectively. Lowest mineralization rates of ammonium and nitrate nitrogen were recorded from millet straw. Application of cow-dung and sheep dropping for increasing ammonium and nitrate nitrogen on sandy loam soils of Adamawa State, Nigeria, could be recommended.

Key words: Mineralization rates, cow-dung, sheep dropping, millet straw, ammonium nitrate nitrogen

Introduction

Crop-livestock interactions are fast evolving in West Africa, mainly due to increased human and livestock population and the resultant agricultural intensification (Smith *et al.*, 1999). The importance of livestock manure is through the transfer of nutrients from rangelands to cultivated lands, thereby providing means of redistribution of nutrients (Tarawali *et al.*, 2001).

As a result livestock transforms poor quality bulky vegetation into products of high economic and nutritive value (Delgado *et al.*, 1999). Since organic matter maintenance is an essential component of sustainable land management, the contribution of manure to soil

organic matter is important; especially as the organic matter fraction in the soil surface horizon contain almost all the N and significant portion of P (Bationo *et al.*, 1998). Increasing soil organic carbon (OC) has positive effects on the availability of nutrients in the soil, as well as increasing cation exchange capacity which act as buffer for pH change as result of fertilizer application (De Ridder and van Keulen, 1990). Effects of livestock manure on soils depend on soil type, livestock specie, location, and season as well as feeds ingested by the livestock (Tarawali *et al.*, 2001). According to Brouwer and Powell, (1998) application of cow-dung, especially at the recommended rate of 9-10 tons ha^{-1} have been reported to increase N and P by

91 kg⁻¹ and 19 kg⁻¹, respectively. Similarly was organic carbon was increased by 10-38% in 0-10cm layer (Nyamangara *et al.*, 2001). De Ridder and van Keulen, (1990), pointed out that, to increase the soil organic carbon by just 1gkg⁻¹ would require a manure application of over 30 tons ha⁻¹ in the initial year, something which may not be feasible, given that the highest rate of application by farmers at 10t ha⁻¹ (Brouwer and Powell, 1998).

Increased availability of nutrients in soil due combine application of millet straw and inorganic fertilizers has been reported in the literature (Bationo *et al.*, 1995; Buerkert *et al.*, 2000). Research conducted in Niger showed that P use efficiency for millet was increased from 46% on plots fertilized with inorganic P to 86% on plots amended with inorganic N and P and millet residue (Bationo *et al.*, 2003). In normal rainfall years, the application of millet residue doubled the P use efficiency of millet despite the very small contribution of residue to the total P supply (Bationo and Buerkert, 2001). On average over a 9-year experiment, Yamoah *et al.* (2002) reported that millet grain yield increased from 320 kg ha⁻¹ on control plots to 700, 900 and 1510 kg ha⁻¹ on plots amended with residue combined with N and P fertilizer. Similar trends were reported for millet stover yield (Buerkert *et al.*, 2000). Fertilizer use efficiency increased from 13.5kggha⁻¹ for the sole fertilized plots to 27.65kggha⁻¹ upon the addition of millet residue (Bationo *et al.*, 1995). Yamoah *et al.* (2002) concluded that the residue combined with fertilizer treatment had the highest sustainability yield index. These increase in grain and stover yields as well as high sustainability yield index have been attributed to the combine effect of residue and inorganic fertilizer application (Buerkert *et al.*, 2000).

Plant-available NH₄⁺ and NO₃⁻ depend on N applied as fertilizers or N mineralized from soil organic matter (Bot and Benites, 2005). Mineralization is a two-step process (aminization and ammonification) that converts organic nitrogen to ammonium nitrogen (Tubonimi, *et al.*, 2008). (Zech *et al.*, 1997). Mineralization rate quantified the amount of ammonium and nitrate nitrogen released in to the soil over time; it is commonly expressed in percentage (Hanselman, *et al.*, 2004). Mineralization is affected with soil type, organic matter content, temperature, moisture,

and oxygen (Harrison, 1987; Martens, 2000; Eghball, 2002; Tubonimi, *et al.*, 2008).

Organic residues in soil are subjected to decay in several, mainly microbial-controlled stages of decomposition (Plaza and Senesi, 2009). In the initial stage, readily decomposable organic compounds, such as sugars, starches, hemicelluloses, and amino acids are rapidly decomposed with production of CO₂ (Zech *et al.*, 1997). This phase is followed by a stage in which organic intermediates and newly formed, biomass tissues are utilized together with the remainder of cellulose and part of the lignin, with production of new biomass and further loss of C as CO₂ (Herrman, 2003). The final stage is characterized by a gradual decomposition of more resistant plant components, such as lignin, and the formation of newly synthesized, more stable products, the humic substances (HS), which may persist for thousands of years (Stevenson and Chen, 1991).

Nutrient availability from applied organic material depends on the rate of mineralization following the application (Nhamo *et al.*, 2004). Assessment of mineralization rates is therefore of fundamental importance since it could be used to predict the nutrient supply mechanisms in agricultural lands (Zech *et al.*, 1997). In high-input agriculture, the assessment of mineralization rates is useful for preventing the danger of nitrate leaching into the groundwater if the supply of nutrients exceeds crop requirements (Campbell *et al.*, 1967). For tropical savanna areas, the measurement of mineralization rates is an important tool for selecting the appropriate fertilizer and proper timing of fertilizer application (Barrios *et al.*, 1997). Furthermore, analysis of temporal and spatial patterns of nutrient mineralization rate can provide important information for synchronizing nutrient supply by mineralized organic materials and the uptake of the nutrients by plants (Manlay *et al.*, 2002; Gachengo *et al.*, 2004).

Materials and Methods

The study was conducted on Teaching and Research Farm of School of Agriculture and Agricultural Technology, Modibbo Adama University of Technology, Yola which is located on latitude 9° 14'N and longitude 12° 38'E (Musa *et al.*, 2007). The soil of the study area is sandy loam in texture, slightly acidic, low in organic carbon, total and available

nitrogen, and available P; moderate in exchangeable bases and slightly high in percentage base saturation.

The soil samples and organic materials (cow-dung, sheep dropping and millet straw) were obtained from Teaching and Research Farm Modibbo University of Technology, Yola. Fifty grams (50g) each of the organic amendments, equivalent to 10 tons ha⁻¹, were incubated in plastic pots after mixing with 10kg soil. Incubation was done inside the laboratory at room temperature. Samples were taken at two weeks intervals up to 12 weeks of incubation. Soil samples were analyzed for ammonium and nitrate nitrogen using standard methods described by Jaiswal (2003). Mineralization rate was estimated using the procedure earlier described by Rodrigues (1998) and Hanselman, *et al.*, (2004).

Results and Discussions

Mineralization Rates of Ammonium and Nitrate Nitrogen from Cow-Dung

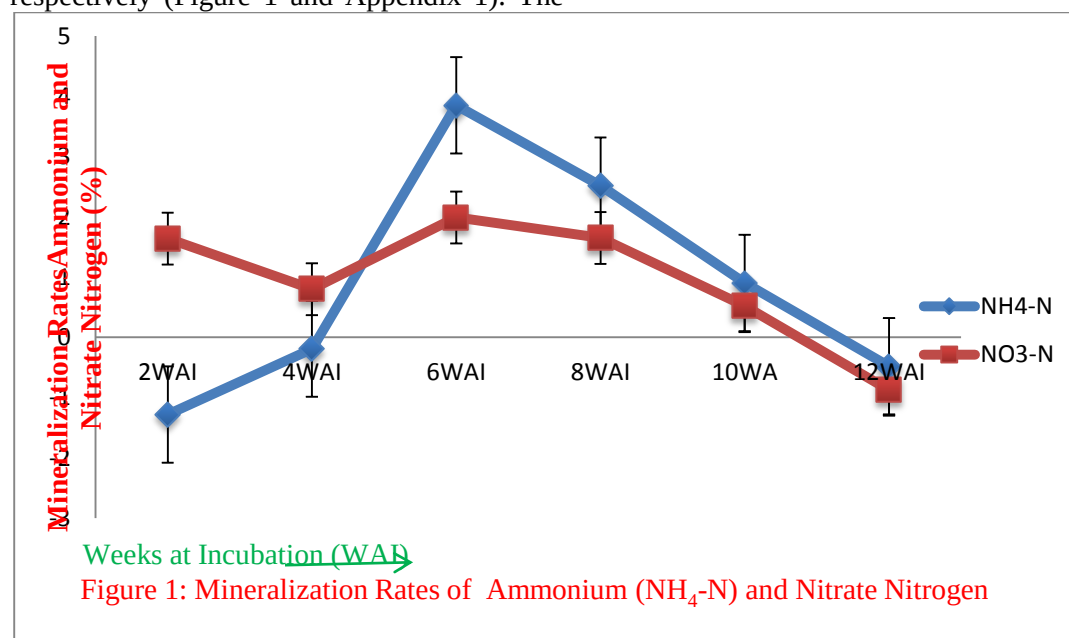
Ammonium nitrogen (NH₄-N) mineralization rate from cow-dung was -1.28, 3.85% and -4.8% at 2, 6 and 12 weeks at incubation (WAI). Nitrate nitrogen (NO₃-N) was 1.64%,

1.99 and -0.87% at 3, 6 and 12WAI, respectively (Figure 1 and Appendix 1). The

mineralization result of NH₄-N and NO₃-N from cow-dung indicates early released of NO₃-N, the peak mineralization rates was at 6WAI. The result indicates that cow-dung contain easily decomposable substances. Martens (2000) earlier reported that organic materials with higher content of phenolic substances decompose much slower. Cow-dung has C:N ratio of 14.53, residues with less than 20:1 C:N have been reported to mineralize more rapidly compared to residues with C: N of 30:1 or higher (Wood *et al.*, 2005). Higher mineralization of NO₃-N observed during the first 2WAI from cow-dung is consistent with what was earlier reported by Nhamo *et al.* (2004).

Mineralization Rates of Ammonium and Nitrate Nitrogen from Sheep-dropping

Mineralization rates of ammonium nitrogen from sheep-dropping was -1.07, 1.94 and -0.05%, at 2, 6 and 12WAI respectively. The nitrate nitrogen was 3.81, 4.19 and 2.49% at 2, 6 and 12WAI respectively (Figure 2 and Appendix 1). The peak mineralization of ammonium and nitrate nitrogen was at 6 and 8WAI, respectively with nitrate recording higher rates (Figure 2).



Higher amount of NO₃-N mineralized during the first 2WAI of incubation indicated

early released of nitrogen from the applied sheep-dropping. Similar results were earlier

reported for tropical savannah soils amended with cow-dung (Sanchez *et al.*, 1997; Manlay *et al.*, 2002; Gachengo *et al.*, 2004). The result indicates early release of $\text{NO}_3\text{-N}$ from sheep which could serve as source of nitrogen for the growing crops.

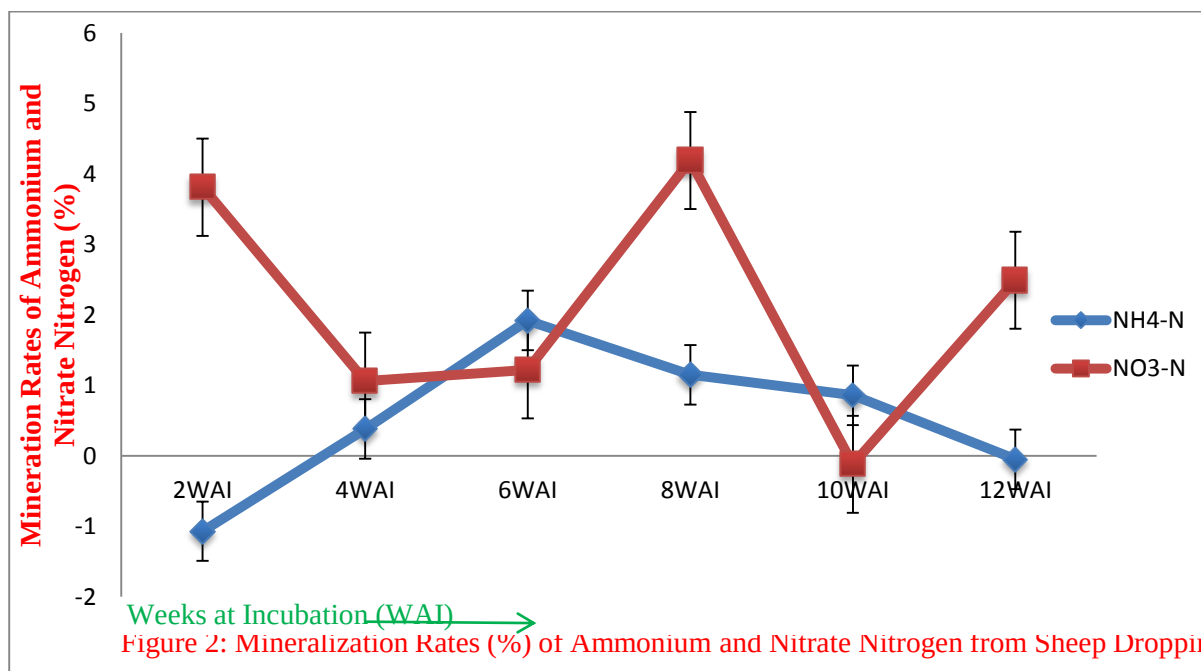
Mineralization Rates of Ammonium and Nitrate Nitrogen from Millet Straw

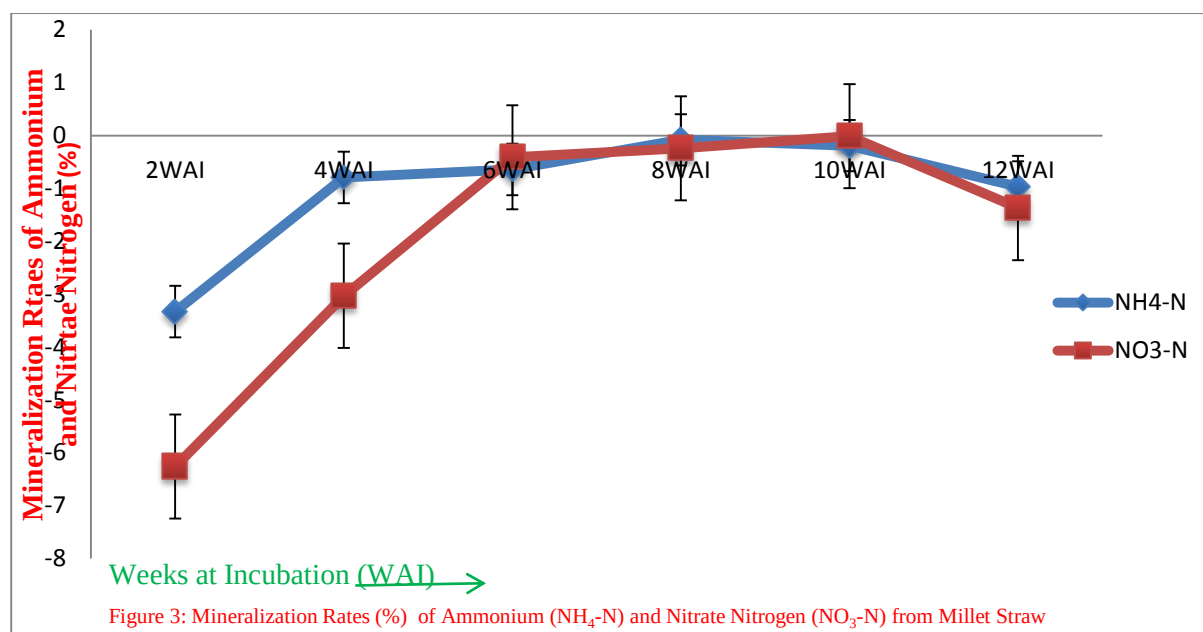
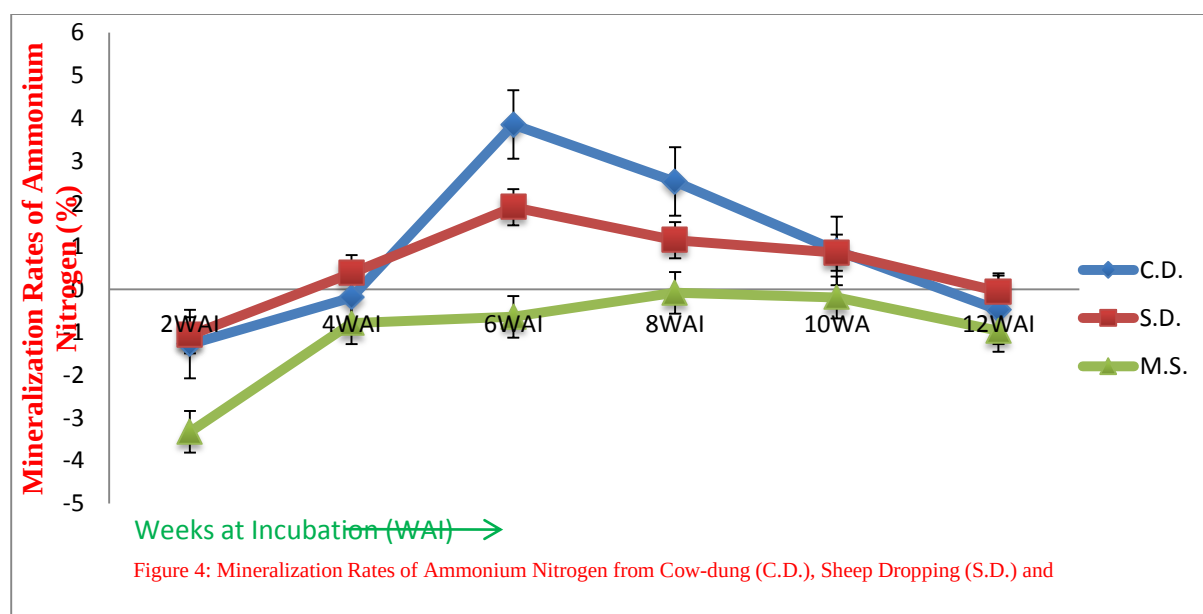
Mineralization rates of ammonium nitrogen from millet-straw was -3.33, -0.08 and -0.97%. For nitrate nitrogen, the mineralization rate was -6.26, -0.24 and -1.37% both at 2, 6 and 12WAI, respectively (Figure 3 and Appendix 1). Negative values throughout the incubation period (12 weeks), indicated immobilization. The result agreed with earlier observations of Alley and Vanluawe, (2009), and could be attributed to wide C: N ratio of the millet straw earlier recorded (152.11). Similar result was also earlier reported by Gachengo *et al.*, 2004), and the negative results obtained could be attributed to higher amounts of C relative to N

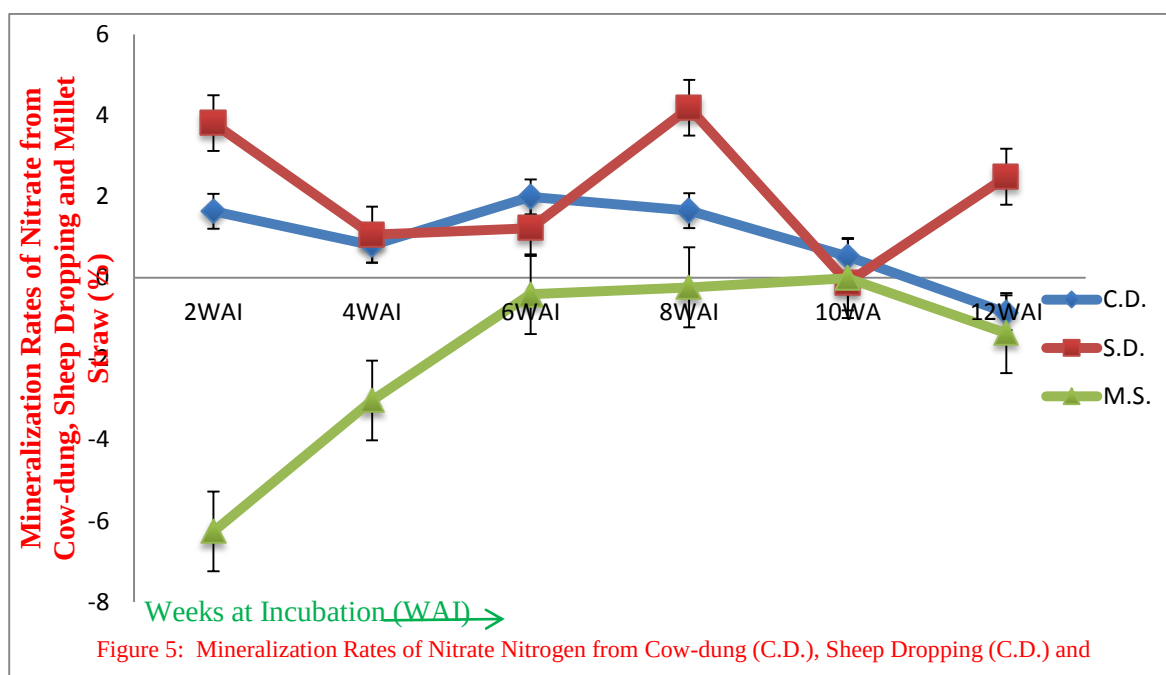
(C: N > 30:1) and which resulted to slow released of ammonium and nitrate nitrogen since soil microorganisms also absorbs mineralized N to increase their populations and energy (Brady and Weill, 2008).

Mineralization Rates of Ammonium and Nitrate Nitrogen from Cow-dung, Sheep-dropping and Millet-straw

Highest ammonium and nitrate mineralization rate of 3.85 and 4.19% was recorded from cow-dung and sheep-dropping at 6WAI and 8WAI (Figure 4, 5 and Appendix 1). The result indicates more ammonium nitrogen was mineralized from cow-dung, while more nitrate nitrogen was mineralized from sheep-dropping. Lowest mineralization of both ammonium and nitrate nitrogen was recorded from millet-straw. As such cow-dung and sheep could be recommended as sources of available nitrogen. The two amendments should be applied 2 to 3 weeks before planting for maximum absorption of the available nitrogen by crops.







Conclusion and Recommendation

It was concluded that cow-dung and sheep could be recommended as sources of available nitrogen. The two amendments should be

applied 2 to 3 weeks before planting for maximum absorption of the available nitrogen by crops.

References

- Alley, M.M. and Vanlauwe, B. (2009). *The role of fertilizers in integrated plant nutrient management*. International Fertilizer Industry Association Tropical Soil Biology and Fertility Institute of the International Centre for Tropical Agriculture, Paris. 61P
- Barrios, E., Kwesiga, F., Buresh, R.J. and Sprent, J.I. (1997). Light fraction soil organic matter and available nitrogen following trees and maize. *Soil Science Society of America Journal*, 61:826- 831
- Bationo, A. and Buerkert, A. (2001). Soil organic carbon management for sustainable land use in Sudano-Sahelian west Africa. *Nutrient Cycling in Agro-ecosystems*, 61:131-142.
- Bationo, A., Buerkert, A., Sedogo, M. P., Christianson, B. C., and Mkwunye, A. U. (1995). A critical review of crop-residue use as soil amendment in the West African Semi-Arid Tropics. In Powell, J. M., Fernandez-Rivera, S. Williams, T. O. and Renard, C., (eds), *Livestock and sustainable nutrient cycling in mixed farming systems of sub-Saharan Africa. Vol. II: Technical Papers*, Proceedings of an International Conference held in Addis Ababa, Ethiopia, 22-26 Nov. 1993, pp 305-322.
- Bationo, A., Christianson, C.B. and Khelaij, M.C. (1993). The effect of crop residue and fertilizer use on pearl millet yields in Niger. *Fertilizer Research*, 34: 251-258.
- Bationo, A., Lompo, F. and Koalo, S. (1998). Research on nutrient flows and balances in West Africa: state-of-the-art *Agriculture, Ecosystem and the Environment*. 71:19-35.
- Bationo, A., Mkwunye, U., Vlek, P. L. G., Koala, S., and Shapiro, A. I. (2003). Soil fertility management for sustainable land use in the West Africa Sudano-Sahelian zone. In: Gichuri, M. P., Bationo, A., Bekunda, M. A., Goma, H. C., Mafongoya, P. L., Mugendi, D. N., Murwira, H. K., Namdwa, S.M. Nyathi, P. and Swift, M. J. (eds). *Soil fertility management in Africa: A regional perspective*, Academic Science Publishers (ASP); Centro Internacional de Agricultura Tropical (CIAT); Tropical Soil Biology and Fertility (TSBF), Nairobi Kenya. pp 253-292.
- Bot, A. and Benites, J. (2005). The importance of soil organic matter. *FAO Bulletin* 80. Food and Agricultural Organisation of the United Nations. Rome, 95p.
- Brady, N.C. and Weil, R.R. (2008). *Nature and Properties of Soils*, 4th edition. Pearson Education Asia. 960 p.
- Brouwer, J. and Powell, J.M. (1998). Increasing nutrient use efficiency in West- African agriculture: the impact of micro-topography on nutrient leaching from cattle and sheep manure. *Agriculture, Ecosystem and Environment*. 71: 229-239.
- Buerkert, A., Bationo, A. and Dossa, K. (2000). Mechanism of residue mulch-induced cereal growth increases in West Africa. *Soil Science Society of America Journal*, 64:346-358.
- Campbell, C. A., Paul, E. A., Rennie, D. A., and McCallum, K.J. (1967). Applicability of the carbon dating method of analysis to soil humus studies. *Soil Science*, 140: 217–223.
- Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S. and Courbois, C. (1999). Livestock to 2020. The next food revolution. Food, Agriculture and the Environment Discussion, Paper 28. International Food Policy Research Institute, Washington, USA. *FAO, Rome, Italy; and International Livestock Research Institute*, Nairobi, Kenya.
- De Ridder, N. and van-Keulen, H. (1990). Some aspects of the role of organic matter in sustainable intensified arable farming system in the West-African semi-arid tropics (SAT). *Fertilizer Resources*. 26:299-310.
- Eghball, B. (2002). Soil properties as influenced by phosphorus- and nitrogen-based manure and compost applications. *Agronomy Journal*, 94:128–135.
- Gachengo, C. N. Vanlauwe, B. and Palm, C. A. (2004b). Mineralisation patterns of selected organic materials, In: (Eds) Derve, R.J. and Probert, M.E. *Modelling nutrient management in tropical cropping systems*. ACIAR Proceedings No. 114, pp 54-61.
- Hanselman, T. A., Graetz, D. A. and Obreza, T. A. (2004). A comparison of in situ methods for measuring net nitrogen mineralization rates of organic soil amendments. *Journal of Environmental Quality* 33:1098–1105.
- Harrison, A. F. (1987). Mineralization of organic phosphorus in relation to soil factors,

- determined using isotopic ^{32}P labeling. In: Rowland, A. P., (ed.) Chemical analysis in environmental research. Abbotts Ripton, NERC/ITE, 84-87. (ITE Symposium, 18). Havlin, J.L., Beaton, J.D., Tisdale, S.L., and Nelson, W.L. (2003). *Soil Fertility and Fertilizers*. Pearson Education, Inc. Singapore 499p.
- Herrmann, A. (2003). Predicting Nitrogen Mineralization from Soil Organic Matter. Doctoral thesis Swedish University of Agricultural Sciences, Uppsala. 42p
- Jaiswal, P.C. 2003. *Soil, Plant and Water Analysis*. Kaylani Publishers. India. 441p.
- Manlay, R. J., Chotte, J.L., Masse, D., Laurent, J.Y. and Feller, C. (2002) Carbon, nitrogen and phosphorus allocation in agro-ecosystems of a West African savanna III. Plant and soil components under continuous cultivation, *Agriculture, Ecosystems and Environment*, 88: 249–269.
- Martens, D.A. (2000). Plant residue biochemistry regulates soil carbon cycling and carbon sequestration. *Soil Biology and Biochemistry*. 32: 361 – 369.
- Musa, H., Singh, L., Usman, B.H., Saddiq, A.M. and Mustapha, S. (2007) Characterization and Classification of the soil developed on basement complex in Federal University of Technology, Yola, Nigeria. *JOLORN*, 8:183-189.
- Nhamo, N., Murwira, H.K. Giller, K.E. (2004). The relationship between nitrogen mineralization patterns and quality indices of cattle manures from different smallholder farms in Zimbabwe. In: (Ed. André Bationo). *Managing Nutrient Cycles to Sustain Soil Fertility in Sub-Saharan Africa*. pp: 299-316
- Nyamangara, J., Gotosa, J. and Mpofu, S.E. (2001). Cattle manure effect on structural stability and water retention capacity of a granitic sandy soil in Zimbabwe. *Soil and Tillage Research*. 62: 157-162.
- Plaza, N. and Senesi, C. The effect of organic matter amendment on native soil humic substances.: In, eds: Senesi, N. et al., 2009. *Biophysico-chemical processes involving natural nonliving organic matter in the environmental systems*. John Willey, pp 169-181.
- Rodrigues, M. Â. 1998. An in situ incubation technique to measure the contribution of organic nitrogen to potatoes . Portugal . angelor@ipb.pt . Crop Science Department Campus Sta Apolónia, Ap. 172; 5301-855 Bragança, Portugal. 32p.
- Sanchez, P. A. Keith D. S., Meredith J. S., Frank M. P., Roland J. B., Anne-Marie N. I., Mokwunye A. U., Fred R. K., Cyrus G. N. and Paul L. W. (1997). Soil Fertility Replenishment in Africa: An Investment in Natural Resource Capital. In: (Eds) Buresh R. J., Sanchez, P. A. and Calhoun, F. *Replenishing soil fertility in Africa, SSSA special publication*, NO 51. P.
- Smith, J.W., Naazic, A., Larbi, A., Agyemang, K. and Tarawali, S.A. (1999). Integrated crop-Livestock systems in sub-Saharan Africa: An option or imperative?. *Outlook Agriculture*, 26:237-246.
- Stevenson, F. J., and Chen, Y. (1991). Stability constants of copper (II) -humate complexes determined by modified potentiometric titration, *Soil Science Society of America Journal*. 55: 1586 –1591.
- Tarawali, S.A., Larbi, A., Fernandez-Rivera, S and Bationo, A. 2001. The contribution of Livestock to soil fertility. In: Sustaining Soil Fertility in West Africa. *Soil Science Society of America Special Publication* no. 58. pp. 281-304
- Tubonimi, I., Igwe, J.K. and Herbert, S.O. (2008). Nitrogen mineralization in selected solid waste dumpsite in Port Harcourt, *Nigeria Journal of Applied Science and Environmental Management*. 12:89-93
- Wood, C. W. Adams, J. F. and Wood, B. H. 2005. Macronutrients. In: Hillel, et al., (eds). *Encyclopedia of soils in the environment*. Volume 2. Academic Press, USA. pp 54-255
- Yamoah, C. F., Bationo, A., Shapiro, B., and Koala, S. (2002). Trend and stability analyses of Millet yields treated with fertilizer and crop residues in the Sahel. *Field Crops Research*, 75:53-62.
- Zech, W., Senesi, N., Guggeberger, G. Kaiser, K., Lehman, J., Miano, T.M., Miltner, A. and Scroth, G. 1997. Factors controlling humification and mineralization of soil organic Matter in the Tropics. *Geoderma*. 79: 117-1

Period of Incubation (WAI)	Cow-Dung						Sheep Dropping						Millet Straw					
	Ammonium-N (%)			Nitrate-N (%)			Ammonium-N (%)			Nitrate-N (%)			Ammonium-N (%)			Nitrate-N (%)		
	2011	2012	C.M.	2011	2012	C.M.	2011	2012	C.M.	2011	2012	C.M.	2011	2012	C.M.	2011	2012	C.M.
2	-0.17 ^{ab}	2.38 ^b	1.28 ^a	10.76 ^a	7.48 ^d	1.64 ^a	3.69 ^d	1.55 ^a	1.07 ^a	22.19 ^a	14.57 ^b	3.81 ^a	6.64 ^b	0.01 ^a	-3.33 ^a	4.33 ^a	8.19 ^c	-6.26 ^b
4	-0.61 ^b	0.22 ^a	0.19 ^a	0.46 ^b	1.14 ^b	0.80 ^a	0.19 ^{bc}	0.57 ^{bc}	0.38 ^a	1.51 ^b	0.60 ^{ab}	1.06 ^a	1.79 ^a	0.22 ^a	-0.79 ^a	3.03 ^a	3.03 ^b	-3.03 ^{ab}
6	7.53 ^a	0.17 ^{ab}	3.85 ^a	2.29 ^b	6.28 ^a	1.99 ^a	2.89 ^a	0.94 ^{ab}	1.92 ^a	0.10 ^b	2.54 ^{ab}	1.22 ^a	1.78 ^a	0.50 ^a	-0.64 ^a	1.51 ^a	2.33 ^a	-0.41 ^a
8	5.80 ^{ab}	0.77 ^b	2.52 ^a	0.62 ^b	3.93 ^a	1.65 ^a	2.16 ^{ab}	0.14 ^{bc}	1.15 ^a	3.20 ^b	5.17 ^a	4.19 ^a	0.20 ^a	0.04 ^a	-0.08 ^a	0.51 ^a	0.04 ^a	-0.24 ^a
10	2.36 ^{ab}	0.56 ^{ab}	0.90 ^a	0.99 ^b	0.04 ^{bc}	0.52 ^a	1.66 ^{a-c}	0.05 ^{bc}	0.86 ^a	0.43 ^b	0.66 ^{ab}	0.12 ^a	0.10 ^a	0.27 ^a	-0.19 ^a	1.25 ^a	1.27 ^a	-0.01 ^a
12	0.29 ^{ab}	0.67 ^{ab}	0.48 ^a	0.10 ^b	1.63 ^c	0.87 ^a	0.06 ^c	0.10 ^c	0.05 ^a	7.15 ^b	2.17 ^{ab}	2.49 ^a	1.60 ^a	0.33 ^a	-0.97 ^a	1.27 ^a	1.46 ^a	-1.37 ^a
SE(±)	1.11	0.23		1.17	1.09		0.57	0.17		2.08	1.1		0.57	0.12		0.94	0.7	