International Journal of Agricultural Research

ISSN 1816-4897

Academic Journals Inc.

www.academicjournals.com

International Journal of Agricultural Research 2 (12): 1043-1048, 2007
ISSN 1816-4897

Comparative Effect of Cowdung Manure on Soil and Leaf Nutrient and Yield of Pepper

B.S. Ewulo, K.O. Hassan and S.O. Ojeniyi
Department of Crop, Soil and Pest Management,
School of Agriculture and Agricultural Technology,
Federal University of Technology, P.M.B. 704, Akure, Ondo State, Nigeria

Abstract: In order to comparative the effect of Cow Dung (CD) manure on soil and leaf nutrient and yield of pepper, two field trials were conducted involving six treatment replicated three times in a randomized complete block design at Ondo, Southwest Nigeria. The six treatments were control, 2.5, 5.0, 7.5 and 10.0 t ha^{-1} CD and 250 kg ha^{-1} NPK fertilizer. Soil, leaf and cow dung N, P, K, Ca and Mg were determined, also soil pH, OM, texture plant numbers of leaves, branches, height, stem girth, number of fruits and fruits weight. OM, N, P, K, Ca and Mg and pH increased with rate of dung. Compared with CD treatments, NPK fertilizer gave less value of soil pH, Ca and Mg. CD increased leaf N, P, K, Ca and Mg contents and leaf N and P increased with dung rate. The 10 t ha^{-1} dung increased leaf P, K, Ca and Mg compared with fertilizer. Growth and fruit yield parameters such as numbers of leaves and branches, plant height and girth and number and weight of fruits increased with level of CD up to 7.5 t ha^{-1}. Relative to control, 2.5, 5.0, 7.5, 10.0 t ha^{-1} dung and NPK fertilizer increased fruit weight by 4, 20, 35, 30 and 34%, respectively and increases in number of fruits were 12, 30, 106, 67 and 103%. Yield increases given by 7.5 t ha^{-1} dung and NPK fertilizer were similar.

Key words: Cow dung manure, NPK fertilizer, *Capsicum annuum*

INTRODUCTION

Pepper (*Capsicum annuum* L.) is a domesticated species of the plant belonging to the family solanaceae and genus *Capsicum*, an herbaceous annual with a densely branched stem and especially productive in warm dry climate. It is widely cultivated for its fruit and are important source of vitamin A, C and E. It is used in medicine as well as food in Africa. *Capsicum* cultivation in the tropics is carried on intensively weathered soils that have degenerated to a state of low activity clay minerals with low native fertility (Jegede, 2004), chemical and biological soil properties of the soil therefore largely depend on Soil Organic Matter (SOM) content, which in itself is subject to high rate of mineralisation and loss. It is not possible to obtain potential crop yield with sustainability where SOC is below 1% and soil having below 2% OC are characterized by lack of cohesion and instability (Greenland *et al*., 1975).

Continuous cultivation of the soil has robbed it of chemicals such as nitrogen, phosphorus and potassium, which are vital for plant growth and are not replaced with organic and chemical fertilizers, pepper yield in Nigeria and other tropical countries is therefore limited by low soil fertility and inability of farmers to purchase inorganic fertilizers due to its scarcity and cost (Tanko, 2000).

Corresponding Author: B.S. Ewulo, Department of Crop, Soil and Pest Management, School of Agriculture and Agricultural Technology, Federal University of Technology, P.M.B 704, Akure, Ondo State, Nigeria Tel: +2348035674245

The long term use of inorganic fertilizer where affordable has been implicated in soil acidification, loss of organic carbon, nutrient imbalance and deficiency of secondary and micronutrients (Ojeniyi, 1981; Adediran and Banjoko, 2003; Osundare, 2004). The trend among the resource poor farmers in the region is therefore the use of organic waste known to increase soil pH, improve soil nutrient (Joann *et al*., 2000; Ano and Agwu, 2005; Ewulo, 2005) and physical properties, especially those from livestock industry that have been found available in large quantity in the tropics (Nwajiuba and Chimezie, 2000).

Recommendations in respect of different organic manures rate for pepper based on research are scarce, there is also the scarcity of organized research on agronomic requirement of pepper especially in Nigeria. In a study on effect of organic manure on yield of pepper in southwest Nigeria (Ibeawuchi, 2003), poultry manure and compost gave significantly higher number of fruits and fruits weight compares with the control. It is hypothesis that cowdung manure will improve tropical soil and plant nutrient composition and the growth and yield of pepper. In the light of the need to identify research into use of organic manures in pepper production and evolve suitable application rates for different agroecological zone of Nigeria, this study was carried out on the comparative effect of Cow Dung (CD) treatments and NPK fertilizer (NPKF) on soil and plant nutrients composition, growth and yield of pepper in Southwest Nigeria.

MATERIALS AND METHODS

Field Trials

Two field trials were conducted at Ondo in the rainforest zone of Nigeria between October and November 2005 and May to July 2006. The land that has been continuously cropped to maize was manually cleared. The six treatments applied to single stands of transplanted pepper seedling were the control (no manure, no fertilizer), 2.5, 5.0, 7.5, 10 t ha^{-1} Cow Dung (CD) and 250 kg ha^{-1} NPK 15-15-15 fertilizer. Treatments were replicated three times in a randomized complete block design. Each plot was 16 m^2 and seedlings were planted at 60×60 cm. The manure and dung were applied by ring method and covered. Ten plants were selected for Data collection per plots and numbers of leaves and branches, plant height, stem girth and leaf area were determined 10 weeks after treatment application. As from 11th week after treatment application, number and weight of fruits were taken at five days interval and accumulated. Data of growth and yield were subjected to analysis of variance and treatment means separated using least significant difference at 5% level probability

Soil Analysis

Soil surface (0-15 cm) samples collected over each site before commencement of trials in 2005 and those collected 16 weeks after treatment application in 2006 (i.e., at completion of experiment) were air dried and 2 mm sieved. Particle size analysis was done using hydrometer (Bouyoucous, 1962). Soil organic matter was determined by wet dichromate method (Nelson and Sommers, 1982), total N by kjeldahl apparatus (Bremner and Mulvancy, 1982) and Available phosphorus was determined by bray P1 and colour was developed in soil extracts using the ascorbic and acid blue colour method (Murphy and Riley, 1962). Exchangeable cations were extracted with ammonium acetate and K was determined on flame photometers, while Ca and Mg were determined using EDTA titration. Soil pH was determined using 1:1 soil-water suspension and 1:2 soil-$CaCl_2$ suspension (Tel and Hagarty, 1984).

Leaf and Cow Dung Analysis

At 10 weeks after treatment application, leaf samples were collected. The samples were oven dried at 70°C for 24 h and milled. Nitrogen was determined using Micro-Kjeldahl method. Samples

were dry ashed using nitric-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 and Hagarty, 1984). Samples of air-dried cow dung used were analyzed as determined for leaf.

Statistical Analysis

Data on soil and leaf analysis, growth and fruit yield were subjected to analysis of variance and means were compared using the Least Significant Difference (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

Analysis of sandy loam soil used for the experiment gave pH ($CaCl_2$) of 6.0, O.M 2.8%, total N 0.25%, available P 8.2 mg kg^{-1}, exchangeable K 0.29 cmol kg^{-1}, Ca 1.6 cmol kg^{-1}, Mg 1.3 cmol kg^{-1}. OM falls within the range of 0.5% and 4% established for soils of southwest Nigeria (Adepetu and Corey, 1976). Considering the critical levels of 3% O.M, 0.15% total N, 10.0 mg kg^{-1} available P, 0.16-0.20 cmol kg^{-1} exchangeable K, 2.0 cmol kg^{-1}, exchangeable Ca, 0.40 cmol kg^{-1} exchangeable Mg set for crop production in Southwest Nigeria (Akinrinade and Obigbesan, 2000). The experimental site O.M, available P and exchangeable Ca was below the critical level and hence it is expected to benefit from cattle dung, an organic source of nutrient.

The CD had pH ($CaCl_2$) 8, 4, 17.4% OM, 4.1% N, 0.18% P, 0.4% K, 0.13% Ca and 0.12% Mg. These values contrast with pH 5.8, 10.0% OM, 1.58% N, 0.97% P, 1.79% K, 1.31% Ca and 0.07% Mg recorded by Adediran *et al.* (1999). The feacal composition of CD varies depending on age of animal and its feed. System of keeping cattle's also affect levels of Total C and N in manure, as those fed on unfertilized and overgrazed pastures are known to have lower Total C and N in their manure compared to those fed from commercial feedlot with high quality fodder and concentrates (Murwiwa and Kirchmann, 1993).

The untreated soil had lowest OM, N, P, K, Ca, Mg and pH. The CD treatments increased the soil constituents and pH, while NPKF expectedly increased soil N, P and K. Soil O.M, N, P, K and Ca tended to increase with level of CD between 0 to 10.0 t ha^{-1}. The addition of the cations to soil by CD led to increase soil pH especially when CD was applied at 5, 7.5 and 10 t ha^{-1}. Therefore CD has high effect on soil. Moyin-Jesu (2007a, b) also found that organic waste such as Cocoa pod husk, duck, turkey and poultry manure increased soil pH, O.M, Mg, Ca, K, P and N.

Compared with NPKF, CD at 5.0, 7.5 and 10 t ha^{-1}, increased soils O.M, N, Ca, Mg and pH. NPKF gave the least pH suggesting that N and P containing fertilizer is acid producing. Similar observation was made by Moyin-Jesu (2007a). Compared with NPKF, CD at 7.5 and 10 t ha^{-1} also increased soil P and K.

Relative to the control, CD at 2.5 t ha^{-1} and above increased soil OM, Ca and Mg significantly ($p>0.05$) while CD at 7.5 and 10 t ha^{-1} also have significant effect on P and K. Therefore CD ensured a more balanced nutrition by supplying Ca and Mg not supplied by NPKF.

In Table 2, it is shown that CD at 2.5 t ha^{-1} and above increased leaf N, P, K, Ca and Mg concentration significantly ($p>0.05$), this attest to the increased availability of these nutrients in soil due to CD application (Table 1). Leaf N, P and K increased with CD levels up to 10.0 t ha^{-1}, while leaf Ca and Mg increased with CD level up to 7.5 t ha^{-1}, Compared with NPKF, CD at 5.0, 7.5 and 10.0 t ha^{-1} increased leaf N, P, K, Ca and Mg. The increases in leaf N, P and K due to application of NPKF is consistent with the concentration of these elements in the fertilizer, while increases in Ca and Mg might be due to enhanced growth of pepper and associated uptake of these elements from native sources (organic and inorganic) in the soil. Earlier study by Moyin Jesu (2007a) also found that plant and animal wastes and NPK (15:15:15) increased uptake of N, P, K, Ca and Mg by coffee seedlings.

Table 1: Soil nutrient composition as affected by Cow Dung (CD) and NPK fertilizer (2006)

Treatments	OM (%)	Total N (%)	P (Mg kg^{-1})	K (cmol kg^{-1})	Ca (cmol kg^{-1})	Mg (cmol kg^{-1})	PH $CaCl_2$
CD (t ha^{-1})							
0	2.79	0.23	8.2	0.26	1.6	1.3	5.80
2.5	2.98	0.26	10.1	0.32	2.1	2.0	5.80
5.0	3.00	1.04	10.2	0.50	2.7	2.8	6.50
7.5	3.22	1.05	15.2	1.60	2.7	3.0	6.50
10.0	3.24	1.03	16.1	1.63	2.8	2.9	6.50
Fertilizer (kg ha^{-1})							
250	2.76	0.67	12.6	1.40	1.7	1.5	5.70
LSD (0.05)	0.18	0.24	2.1	0.30	0.4	0.6	0.07

Table 2: Nutrient composition of pepper leaf as affected by Cow Dung (CD) and NPK fertilizer (2006)

Treatments	N (%)	P (%)	K (%)	Ca (%)	Mg (%)
CD (t ha^{-1})					
0	3.00	0.14	2.33	0.67	0.09
2.5	5.20	0.19	2.65	0.89	0.12
5.0	5.20	0.30	2.66	0.96	0.17
7.5	5.80	0.40	2.77	0.98	0.21
10.0	7.40	0.55	2.40	0.87	0.14
Fertilizer (kg ha^{-1})					
250	5.40	0.17	2.05	0.72	0.13
LSD (0.05)	0.02	0.03	0.27	0.12	0.04

Table 3: Effect of Cow Dung (CD) and NPK fertilizer on pepper-2005

Treatments	No. of leaves plant^{-1}	Plant height (cm)	Stem girth (cm)	No. of branches	No. of fruit plant^{-1}	Fruits weight plant^{-1}
CD (t ha^{-1})						
0	176.0	31.6	2.3	17.0	28.4	259.0
2.5	221.0	34.3	2.4	22.0	31.4	279.0
5.0	257.0	38.3	2.8	25.0	38.0	342.0
7.5	315.0	44.2	3.2	31.0	60.8	380.0
10.0	299.0	39.7	2.9	25.0	42.9	374.0
Fertilizer (kg ha^{-1})						
250	325.0	43.6	3.2	31.0	59.5	380.0
LSD (0.05)	27.8	3.0	0.3	2.8	11.6	34.5

Table 4: Effect of Cow Dung (CD) and NPK fertilizer on pepper-2006

Treatments	No. of leaves plant^{-1}	Plant height (cm)	Stem girth (cm)	No. of branches	No. of fruit plant^{-1}	Fruits weight plant^{-1}
CD (t ha^{-1})						
0	219.0	27.2	3.10	24.0	35.1	307.8
2.5	290.0	28.5	3.10	26.0	39.8	310.4
5.0	311.0	33.1	3.40	30.0	44.5	349.4
7.5	408.0	42.9	3.70	44.0	70.2	383.5
10.0	386.0	36.9	3.60	41.0	63.4	361.1
Fertilizer (kg ha^{-1})						
250	409.0	42.5	3.70	43.0	69.7	375.9
LSD (0.05)	61.7	6.0	0.22	9.1	16.2	36.2

Mbah (2006) found that poultry, cowdung and swine manures increased uptake of k, Ca and Mg by maize on leptosol of southeast Nigeria. Mbah and Mbagwu (2006) found that the animal wastes increased soil OM, N and cation exchange significantly.

CD treatments at 2.5 t ha^{-1} and above and NPKF increased growth and fruit yield parameters of pepper such as numbers of leaves, plant height, stem girth, number of branches, number and weight of fruits significantly ($p>0.05$). This is especially the case with application of CD at 5.0 t ha^{-1} and above. The 7.5 t ha^{-1} CD gave highest values of these parameters in most cases in both years of study and had similar values of numbers and weight of fruits compared with NPKF. It is therefore recommended (Table 3, 4).

The increase in growth and yield parameters due to application of CD and NPKF treatments is consistent with increases in uptake of N, P, K, Ca and Mg as indicated by leaf analysis. It is therefore suggested that pepper grown on the soil requires these nutrients.

The highest yield given by 7.5 t ha^{-1} CD is consistent with the highest leaf K, Ca and Mg recorded for treatment (Table 2). Application of highest level of CD might have cause dilution effect on K, Ca and Mg concentrations in soil at critical stage of the crops growth due to excess OM and N, thus given a situation of nutrient imbalance in soil and crop. Also OM and N being acid producing (Brady and Weil, 1999) might have caused neutralization of some of the cations at critical stage of growth and fruit formation. Hence leaf K, Ca and Mg dropped between 7.5 and 10.0 t ha^{-1} CD. It is therefore suggested that leaf nutrient concentration of 5.8% N, 0.40% P, 2.77% K, 0.98% Ca and 0.21% Mg were adequate for the pepper crop. These values contrast with 3.2-4.8, 0.32-0.48, 2.5-4.2, 1.7-4.0 and 0.45-0.70% given as sufficiency ranges for tomato (*Capsicum annuum* L.) (Brady and Weil, 1999).

It is concluded from this study that CD ensured more availability of nutrients especially cations in soil and in pepper plant compared with NPK fertilizer especially when applied at 7.5 t ha^{-1}, the material is an effective source of N, P, K, Ca, Mg and OM for pepper plants and it served to reduce soil pH. It is recommended for use at 7.5 t ha^{-1}, which gave similar yield and growth parameters as recommended NPK fertilizer. Since the CD is abundant as waste in abattoirs located in urban centers in Nigeria and is often left as waste, it can be put to use as source of nutrients and manure to pepper in production.

REFERENCES

Adediran, J.A., M.O. Akande, L.B. Taiwo and R.A. Sobulo, 1999. Comparative Effectiveness of Organic Based Fertilizer with Mineral Fertilizer on Crop Yield. In: Proceedings of Soil Science Society of Nigeria Conference, Babalola, O. (Ed.), pp: 91-95.

Adediran, J.A. and V.A. Banjoko, 2003. Comparative effectiveness of some compound fertilizer formulations for maize production in Nigeria. Nig. J. Soil Sci., 13: 24-49.

Adepetu, J.A. and R.B. Corey, 1976. Changes in N and P availability and P fractions in Iwo series from Nigeria under intensive cultivation. Plant and Soil, 46: 309-316.

Akinrinade, E.A. and G.O. Obigbesan, 2000. Evaluation of the fertility status of selected soils for crop production in five ecological zones of Nigeria. In: Proceedings of the 26th Annual Conference of Soil Science Society of Nigeria, Ibadan, pp: 279-288.

Ano, O.A. and J.A. Agwu, 2005. Effect of animal manure on selected soil chemical properties (1). J. Soil Sci., 15: 14-19.

Bouyoucous, C.J., 1962. Hydrometer method for making particle size analysis of soil. Soil Sci. Soc. Am. Proc., 26: 464-465.

Brady, W.C and R.R. Weil, 1999. The Nature and Properties of Soils. Prentice-Hall, New Jersey, pp: 881.

Bremner, J.M. and C.S. Mulvancy, 1982. Nitrogen-Total. In: Methods of Soil Analysis. Page, A.L. (Ed.), Part 2, Agron Monogr. 9 2nd Edn., ASA and SSSA, Madison, WSC, pp: 403-430.

Ewulo, B.S., 2005. Effect of poultry dung and cattle manure on chemical properties of clay and sandy clay loam. J. Anim. Vet. Adv., 4: 839-841.

Greenland, D.J., D. Rimmer and D. Payne, 1975. Determination of the structural stability class of English and Welsh soils, using a water coherence test. J. Soil Sci., 26: 294-303.

Ibeawuchi, I.I., 2003. Effect of four organic manure types on yield of pepper (*Capsicum annum*) in Southeastern Nigeria. Paper Presented at 21st Conference of Hortiultural Society Nigeria Lagos, pp: 10-13.

Jegede, G., 2004. Survey of predominant clay minerals from selected soils in Southwest Nigeria. Nig. J. Soil Sci., 14: 85-86.

Joann, K., Whalema, Chi Changa, W. George Claytonb and P. Janna Care Carefoota, 2000. Cattle Amendments can increase the pH of acid soils. Soil Sci. Soc. Am. J., 64: 962-966.

Mbah, C.N., 2006. Influence of organic wastes on plant growth parameters and nutrient uptake by maize (*Zea mays* L.). Nig. J. Soil Sci., 16: 104-108.

Mbah, C.N. and J.S.C. Mbagwu, 2006. Effect of animal wastes on physicochemical properties of a uystric leptosol and maize in southwestern Nigeria. Nig. J. Soil Sci., 16: 96-103.

Moyin-Jesu, E.I., 2007a. Effect of some organic fertilizers on soil and coffee (*Coffea arabica* L.) chemical composition and growth. University of Khartoum. J. Agric. Sci., 15: 52-70.

Moyin-Jesu, E.I., 2007b. Use of plant residues for improving soil fertility, pod nutrients, root growth and pod weight of Okra (*Abelmonschos esculentus*). Bioresource Technol., 98: 20574-2064.

Murphy, J. and J.P. Riley, 1962. A modified single solution method for determination of phosphorus in natural water. Anal. Chimica Acta, 27: 31-36.

Murwiwa, H. and H. Kirchmann, 1993. Carbon and Nitrogen Mineralisation of Cattle Manures, Subjected to Different Treatments, in Zimbabwean and Swedish Soils. In: Soil Organic Matter Dynamics and Sustainability of Tropical Agriculture. Mulongoy, K. and R. Merckx (Eds.), A Wiley-Sayce Co-Publication, pp: 189-198.

Nelson, D.W. and L.S. Sommers, 1982. Total Carbon, Organic Carbon and Organic Matter. In: Method of Soil Analysis. Page, A.L. (Ed.), Part 2. Agron. Monogr. 9. 2nd Edn., ASA and SSSA, Madison, WSC, pp: 539-579.

Nwajiuba, C. and P. Chimezie, 2000.The use of Livestock wastes in Soil fertility regeneration in Imo state of Nigeria. In: Proceedings of the 1st Annual Conference of the College of Agriculture and Veterinary Medicine, Abia State University, Nigeria, pp: 137-140.

Ojeniyi, S.O., 1981. Effect of long term NPK application on secondary and micronutrient content of Coffea Carephora. Plant and Soil, 60: 477-480.

Osundare, B., 2004. Effect of different companion crops and fertilizer types on soil nutrient dynamics and performance of cassava. Nig. J. Soil Sci., 14: 13-17.

Tanko, L., 2000. Socio economic factors affecting fertilizer demand in small holder farming system under subsidy withdrarwal. In: Proceedings of the 1st Annual Conference of the College of Agriculture and Veterinary Medicine, Abia State University, Nigeria, pp: 84-97.

Tel, D.A. and M. Hagarty, 1984. Soil and Plant Analysis, IITA Ibadan/University of Guelph, Ontario Canada, pp: 277.