Research Journal of Agronomy 2 (2): 44-47, 2008
ISSN: 1815-9354

Residual Effect of Goat and Poultry Manures on Soil Properties Nutrient Content and Yield of Amanranthus in Southwest Nigeria

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Abstract: The residual effect of goat manure (GM) and Poultry Manure (PM) applied at 0, 5, 10 and 15 t ha^{-1} to pepper was investigated 1 year after application in Akure, Southwest Nigeria. Amaranthus was used as test crop. The effect on some soil physical and chemical properties and leaf nutrient content, growth and yield of amanranthus was studied. The manures reduced soil bulk density, temperature and increased moisture content significantly ($p>0.05$). The soil bulk density reduced and moisture content increased with level of manure. Manured soil had higher values of soil organic matter, N (PM only), P, K, Ca and Mg than untreated soil and soil P increased with level of manure. The effect of GM on soil N was not significant. As opposed to PM, GM applications increased significantly leaf N, P, K, Ca and Mg and marketable yield of amaranthus. The increases given by 5, 10 and 15 t ha^{-1} GM were 12, 39 and 47%, respectively. The effect of 10 and 15 t ha^{-1} GM on yield was similar.

Key words: Residual effect, soil, nutrients, amanranthus, Nigeria

INTRODUCTION

In Nigeria, ground goat manure (droppings), its slurry and poultry manure are used by vegetable growers to supply nutrients. This is because of high cost and scarcity of chemical fertilizers. Farmers are reluctant to use chemical fertilizers especially at household levels (Olasantan, 1994; Awodun *et al*., 2007). Studies have shown that Poultry Manure (PM) is effectively increasing soil fertility, yield and nutrient content of crops and soil physical properties (Ojeniyi and Adeniyan, 1999; Mbagwu, 1995; Adeniyan and Ojeniyi, 2003, 2005; Ewulo *et al*., 2007; Akanni *et al*., 2005; Akanni and Ojeniyi, 2007). Field experiments (Odide *et al*., 1999; Akinola and Ojeniyi, 2000; Ojeniyi and Adejobi, 2002; Ojeniyi and Adegboyega, 2003; Odedina *et al*., 2007; Awodun and Olafusi, 2007) also confirmed that Goat Manure (GM) increased soil nutrient pH, nutrient status and yield of okra, sweet pepper, celosia, tomato, amaranthus and maize.

The boost in poultry production in Nigeria led to abundance of its waste. Although, GM is not as abundant as PM, it has been used as source of nutrients for vegetables (Akinola and Ojeniyi, 2000). Repetitive use of the waste especially GM in instances led to reduced leaf production and nutrient deficiency symptoms (due nutrient imbalance) as a result of oversupply of some nutrients compared with others. Hence, it is necessary to study residual effect of manures in order to recommend suitable frequency of application. Adenawoola and Adejoro (2005) investigated residual effect of PM at 30-50 t ha^{-1}. At 1 year after application, PM increased soil organic matter (OM), N, P, K, Ca and Mg and yield of (*corchoros olitorius*). Adeniyan and Ojeniyi (2003) studied residual comparative effect of PM (tlha) and combinations of reduced levels of PM and NPK fertilizer on second maize crop. The treatments had residual effect on soil nutrients, nutrient uptake and gain yield. The PM had greater effect than fertilizer.

The aim of this research was to study residual effect of PM and GM on soil physical and chemical properties, nutrient content and yield of amaranthus in southwest Nigeria.

MATERIALS AND METHODS

Field experiment: Experiments were conducted at (sites 1and 2), respectively at Federal College of Agriculture, Akure southwest Nigeria to test residual effect of GM and PM applied by broadcast to pepper (*Capsicum annum*) in August 2005. The sites were initially low in OM with a mean of 1.34%, available P 4.3 mg kg^{-1}, total N 0.08%, but initially marginal in exchangeable K (0.16 and 1 kg^{-1}), adequate in Aa (1.83 and 1 kg) and

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magnesium (0.91 and 1 kg). The test crop was amaranthus. There were 4 levels of the manures replicated four times on pepper between August and November 2005. The 4 levels were 0, 5,10 and 15 t ha^{-1}. In August 2006, treated plots were manually cleared. Each of the twelve 25 m^2 plots in the 2 sites was planted to amaranthus using a randomized complete block design. Amaranthus seedlings were transplanted at two weeks old at 30×15 cm, given a plant population of 222, 222 ha^{-1} at each site. Weeding was done 3 times.

At 7 weeks after planting, growth and yield parameters such as plant height, stem girth, number of leaves per plant, fresh matter (marketable) yield were determined using twenty plants per plot. Harvested plants were uprooted for determination of taproot length.

Soil physical properties: Three steel core samples were taken per plot to 10 cm depth after harvest for the determination of soil bulk density and gravimetric moisture content. The soil thermometer was used for determination of temperature to 5 cm depth in 3 replicate per plot.

Soil chemical properties: Soil samples were collected using augers to 15 cm depth and bulked for each plot in each site. The samples were cur-dried and sieved using 2 mm diameter sieve. Routine soil analysis was done as described by Carter (1993). The soil pH in 1:2 soil-water medium was determined using electrode. Organic matter was determined using chronic acid digestion, while N was determined by micro-kjeldahl method. The available P was determined by molybdenum blue colourmetry after Bray-1 extraction. The exchangeable K, Ca and Mg were extracted using ammonium acetate, K was determined using flame photometer and Ca and Mg by EDTA titration.

Leaf analysis: Leaf samples collected at harvest was bulked for each plot, dried at 80°C and ground for routine analysis (AOAC, 1990). The samples were digested using antic-peschloric acid digestion. Percent N was determined using micro-kjeldahl approach, P by vanado-molybdate method, K by flame photometer and Ca and Mg by EDTA titration.

Data were subjected to analysis of variance and means compared using least significant difference at 5% level.

RESULTS AND DISCUSSION

Table 1 presents data on soil physical properties as influenced by goat manure (GM) and Poultry Manure (PM). At one year after application, manure applied at 5, 10 and 15 t ha^{-1} has significant ($p>0.05$) residual effect on soil bulk density (Db) by reducing soil Db relative to no manure. The manured plots has similar values of Db which were significantly higher than those of untreated plots. The bulk density reduced with increasing rate of manure between 0-15 t ha^{-1}. Soil Moisture Content (MC) and hence, moisture retention was increased significantly by 10 and 15 t ha^{-1} manure in case of both types of manure. Moisture content tended to increase with level of manure. Although, PM did not influence soil temperature significantly ($p>0.05$), GM application reduced soil temperature when applied at 5, 10 and 15 t ha^{-1}. The 10 and 15 t ha^{-1} PM gave similar value of soil temperature. The finding that GM and PM had residual effect and improved soil physical properties is similar to the findings of Mbagwu (1995), Akanni *et al.* (1995) and Adesodun *et al.* (2001) who found that PM improved soil physical conditions and this was attributed to supply of organic matter (Table 2). As shown by the present study, GM and PM still had positive effect on soil physical properties at 1 year of their application. The residual effect reflected with application of manure at 5 t ha^{-1} and above. The organic matter supplied by the manures should have stabilized soil structure thereby improving its porosity and reducing its density. The latter effects should have aided water infiltration and reception (Tisdale and Oades, 1982).

Table 2 shows data on soil chemical properties. It is shown that GM and PM had residual effect on soil chemical properties since the value of soil OM, N (PM

Table 1: Residual effect of goat (GM) and poultry manure (PM) on soil physical properties

Manure (t ha^{-1})	Temperature (°C)	Bulk density (g cm^{-3})	Moisture content (%)
0GM	36.5	1.06	7.1
5GM	35.7	0.98	7.2
10GM	34.8	0.96	7.4
15GM	34.8	0.86	8.2
LSD (0.05)	0.60	0.14	0.2
0PM	34.8	1.06	6.76
5PM	34.8	0.90	7.20
10PM	34.5	0.89	8.15
15PM	34.1	0.85	8.15
LSD (0.05)	NS	0.13	0.24

Table 2: Residual effect of goat (GM) and poultry manure (PM) on soil chemical properties

				K	Ca	Mg
Manure (t ha^{-1})	OM (%)	N (%)	P (mg kg^{-1})	cmol kg^{-1}		
OGM	1.16	0.07	3.9	0.09	0.70	0.60
5GM	1.13	0.08	4.1	0.14	0.80	0.62
10GM	1.41	0.08	4.3	0.18	0.82	0.73
15GM	1.42	0.08	4.5	0.12	0.88	0.74
LSD (0.05)	0.07	NS	0.5	0.08	0.13	0.10
OPM	1.14	0.07	3.9	0.11	0.71	0.61
5PM	1.38	0.16	4.0	0.15	0.85	0.64
10PM	1.45	0.22	4.2	0.23	0.88	0.75
15PM	1.52	0.22	4.7	0.23	0.87	0.73
LSD (0.05)	0.20	0.05	0.6	0.06	0.15	0.10

alone) available P, K, Ca and Mg were increased relative to the control. The GM at 10 and 15 t ha^{-1} increased soil OM, Ca and Mg significantly ($p>0.05$), while GM at 15 t ha^{-1} only increased soil P and K significantly. The PM at 5 t ha^{-1} and above increased soil OM and N significantly ($p>0.05$) while PM at 10 and 15 t ha^{-1} increased soil P, K, Ca and Mg significantly. Soil OM and P increased with level of manure.

Effect of GM on soil N was not significant and its values were comparatively low compared with values recorded for PM. Thus, surgest that the N was exhausted expectedly by amaranthus, which is known to depend mainly on N availability. Because N was depleted in soil given GM, thus should have led to enhanced marketable yield of amaranthus. The finding that the manures improved soil nutrients content is consistent with earlier findings of Adeniyan and Ojeniyi (2005), Akanni *et al.* (2005) and Ewulo (2005) on PM. The GM has been found (Akinola and Ojeniyi, 2000; Ojeniyi and Adejobi, 2002; Ojeniyi and Adegboyega, 2003; Odedina *et al.*, 2007) to improve soil fertility and vegetable yield. It is affirmed by the present study that the effect of PM and GM on soil fertility persists for 1 year.

The leaf nutrient concentrations are shown in Table 3. For both GM and PM, leaf N, P, K, Ca and Mg concentrations increased with level of manure applied one year ago. Therefore, the manure treatments still influenced nutrient status of amaranthus. However, the effect of PM applications did not influence nutrient content of amaranthus significantly ($p>0.05$). However, GM treatments increased amaranthus nutrient status significantly ($p>0.05$). For all determined nutrients application of GM at 10 and 15 t ha^{-1} has significant effect. Therefore, as opposed to PM, GM application increased significantly the leaf N, P, K, Ca and Mg contents of amaranthus a year after its application.

The data on growth and yield parameters of amaranthus are presented in Table 4. Parameters such as plant height, tap root length, number of leaves, stem girth and marketable yield increased with level of GM, but only to 10 t ha^{-1} incase of PM. Thus the manures had residual effect but the effect was only significant ($p>0.05$) for marketable yield incase of GM. It was not significant for marketable yield incase of PM. Therefore, GM had residual effect on yield, but the effect of PM was not significant. The significant effect recorded for GM is content with the significant effect of its applications on N uptake (Table 3). The PM applications did nor significantly influence uptake of any nutrient determined. Whereas, GM application significantly increased uptake of N, P, K, Ca and Mg. Hence, its significant residual effect on yield.

Table 3: Residual effect of Goat (GM) and Poultry Manure (PM) on leaf and yield of amaranthus

Manure t ha^{-1}	N (%)	P (%)	K (%)	Ca (%)	Mg (%)
0GM	0.09	0.11	0.46	0.64	0.53
5GM	0.12	0.15	0.55	0.65	0.54
10GM	0.16	0.16	0.56	0.67	0.55
15GM	0.17	0.17	0.58	0.69	0.56
LSD (0.05)	0.01	0.04	0.08	0.02	0.02
0 PM	0.45	0.12	0.46	0.64	0.54
5PM	0.48	0.14	0.55	0.66	0.53
10PM	0.50	0.18	0.57	0.66	0.56
15PM	0.49	0.20	0.58	0.68	0.58
LSD (0.05)	NS	NS	NS	NS	NS

Table 4: Residual effect of goat (GM) are poultry manure (PM) on growth and yield of amaranthus

Manure t ha^{-1}	Plant height (cm)	Tap root length (cm)	No of leaves	stem girth (cm)	Yield t ha^{-1}
0 GM	31.9	15.3	32.3	5.0	8.6
5GM	33.3	15.8	33.3	5.1	9.7
10GM	35.3	15.5	34.7	5.2	11.9
15GM	35.6	16.4	35.5	5.3	12.7
LSD (0.05)	NS	NS	NS	NS	3.1
0 PM	31.2	14.8	31.1	3.5	3.9
5PM	31.5	14.7	32.0	3.7	4.2
10PM	31.7	14.8	33.2	3.8	4.2
15PM	31.7	14.6	32.7	3.8	3.9
LSD (0.05)	0.4	NS	1.0	0.1	NS

Lack of significant effects on PM on nutrient uptake and yield could be due to its ease of decomposition which should have enhanced leaching and volatilization (incase of N) of nutrients released. The PM has relatively low C:N ratio (4.5-6.0) compared to 8.0 for GM (Awodun *et al.*, 2007). Akanni *et al.* (2005) found that PM contained more N than goat, pig and cattle manures. Olayinka (1990) indicated that because of its low C:N ratio, PM tended to decompose fast and release its nutrients. Hence at the end of one year of its application, PM at up to 15 t ha^{-1} had no significant residual effect on nutrient status and yield of amaranthus when applied at 10 t ha^{-1}. The significant effect of PM could also be due to low application. Adenawoola and Adejoro (2005) observed significant residual effect of PM on soil nutrient and conchorus yield when applied at 30-50 t ha^{-1}. The increases in marketable yield of amaranthus given by 5, 10 and 15 t ha^{-1} GM were 12, 39 and 47%, respectively. The 10 t ha^{-1} GM gave significant yield increase that was similar to that given by 15 t ha^{-1} GM.

RECOMMENDATIONS

It is recommended that poultry manure at nor more than 15 t ha^{-1} be applied annually to vegetable crops such as pepper and amaranthus, while goat manure that had more residual effect be applied biennially to reduce cost of production and possible soil and water pollution by the animal wastes. For significant residual effect on crop, application of GM at 10 t ha^{-1} is recommended.

REFERENCES

Adenawoola, A.R. and S.A. Adejoro, 2005. Residual effects of poultry manure and NPK fertilizer residues on soil nutrient and performance of jute (*Corchorus olitorius* L.). Res. Note. Nig. J. Soil Sci., 15: 133-135.

Adeniyan, O.N. and S.O. Ojeniyi, 2003. Comparative effectiveness of different levels of poultry manure with NPK fertilizer on residual soil fertility nutrient uptake and yield of maize. Moor J. Agric. Res., 4: 191-197.

Adeniyan, O.N. and S.O. Ojeniyi, 2005. Effect of poultry manure NPK 15-15-15 and combination of their reduced levels on maize growth and soil chemical properties. Nig. J. Soil Sci., 15: 34-41.

Adesodun, J.K., J.S.C. Mbagwu and N. Oti, 2005. Distribution of carbon nitrogen and phosphorus in water stable aggregates of an organic waste amended ultisol in Southeastern Nig. Bioresour. Technol., 96: 509-516.

Akanni, D.I. and S.O. Ojeniyi, 2007. Effect of different levels of poultry manure on soil physical properties nutrient status growth and yield of tomato. Res. J. Agron., 1: 1-4.

Akanni, D.I., S.A. Odedina and S.O. Ojeniyi, 2005. Effect of animal manures on soil properties growth nutrient status and yield of tomato in Southwest Nig. Moor J. Agric. Res., 6: 70-75.

Akinola, M.O. and S.O. Ojeniyi, 2000. Effect of goat manure on soil nutrients and Okra yield. Applied Trop. Agric., 5: 20-23.

Association of Official Analytical Chemists (AOAC), 1990. Official Methods of Analysis. 15th Edn. Washington, DC.

Awodun, M.A. and R.A. Olafusi, 2007. Effect of integrated application of goat manure and urea on soil nutrient content and yield of Okra. Nig. J. Soil Sci., 17: 126-129.

Awodun, M.A., L.I. Omonijo and S.O. Ojeniyi, 2007. Effect of goat dung and NPK fertilizer on soil and leaf nutrient content growth and yield of pepper. Int. J. Soil Sci., 2: 142-147.

Carter, M.R., 1993. Soil sampling and methods of analysis. Canadian Society of Soil Science items Publishers. London, pp: 823.

Ewulo, B.S., K.O. Hassan and S.O. Ojeniyi, 2007. Comparative effect of cowdung manure on soil and leaf nutrient and yield of pepper. Int. J. Agric. Res., 2: 1043-1048.

Mbagwu, J.S.C., 1995. Subsoil productivity of an ultisol in Nigeria as affected by organic wastes and inorganic fertilizer treatments. Soil Sci., 140: 436-441.

Odedina, S.A., S.O. Ojeniyi and M.A. Awodun, 2007. Effect of agro-industrial wastes on nutrient status and performance of tomato. Global J. Environ. Res., 1: 18-21.

Odide, I., S.O. Ojeniyi, O.M. Akinola and A.A. Achor, 1999. Effect of goat dung manure on soil chemical properties and yield components of okra. Proc. 25th Annu. Conf. Soil Sci. Soc. Nig. Benin, pp: 174-178.

Ojeniyi, S.O. and A.A. Adegboyega, 2003. Effect of combined use of urea and goat dung manure on celosia. Nig. Agric. J., 34: 87-90.

Ojeniyi, S.O. and N.O. Adeniyan, 1999. Effect of poultry manure and NPK fertilizer on soil fertility nutrients content and yield of maize at Akure, Southwest Nigeria. Proc. 25th Annu. Conf. Soil Sci. Soc. Nig. Benin, pp: 185-191.

Ojeniyi, S.O. and S.K. Adejobi, 2002. Effect of ash and goat dung manure on leaf nutrients composition growth and yield of amaranthus. Nig. Agric. J., 33: 46-57.

Olasantan, F.O., 1994. Fertilizer use in vegetable production in Nigeria. Outlook on Agric., 23: 213-222.

Olayinka, A., 1990. Effects of poultry manure corn straw and sawdust on plant growth and soil chemical properties. Ife J. Agric., 12: 36-44.

Tisdale, S.L. and J.M. Oades, 1982. Organic matter and water stable aggregate in soil. J. Soil Sci., 33: 141-147.