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Effect of Poultry Dung and Cattle Manure on Chemical Properties of Clay and Sandy Clay Loam Soil

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Abstract: In order to investigate the effect of poultry dung and cattle manure on clay and sandy clay loam soil chemical properties, an incubation experiment was carried out in which clay and sandy clay loam soil were amended with poultry and cattle manure at 0, 20, 40 and 60 g kg^{-1}. The soil treated was incubated in the dark at 25°C for eight weeks at field capacity. Soil pH, O.C, N, P, K, Ca, Mg, Na and CEC increased with rate of manure, while exchangeable acidity reduced irrespective of soil type. The poultry manure gave quick response and higher concentration of soil chemical properties especially in case of the clay soil.

Key words: Soil, incubation, amended, field capacity, manure

INTRODUCTION

Soils of the humid tropics are known to be low in organic matter and mark depletion in its store occurs within two years of cultivation. It functions as the principal source of nutrients; its decline therefore affects not only crop yield but also the physical and chemical properties of soil. Animal manure is on the other hand is known to be effective in maintenance of adequate and adequate supply of organic matter in soil, with attendant improvement in soil physical and chemical condition and enhanced crop performance[1-2], its generation is also known to be substantial[3]. Poultry, cattle, goat, sheep and pig manure has been found to improves soil fertility and crop yield[4-5], sheep manure is more effective than cattle manure in improving the yield of millet[2]. There is need for more research information on the relative effect of manure on different soil types (texture). This incubation study examines the relative effect of poultry and cattle dung on chemical properties of two soil types.

MATERIALS AND METHODS

Incubation trial was conducted on clay and sandy clay loam soil at the soil laboratory of the Federal University of Technology, Akure. Fresh poultry and cattle manure were collected from livestock section of the University and were air-dried and allowed to mature. Two sets of 4 kg clay soil were measured, the first set was amended with 0, 20, 40 and 60 g kg^{-1} of poultry manure and the second set amended also with the same rate of cattle manure. Two sets of 4 kg sandy clay loam were also measured and mixed in the same manner with poultry dung and cattle manure, respectively. Amended soils were packed in labeled plastic pots, watered to field capacity and covered by wet foam which allow air exchange but prevented soil from drying out. They were placed in the dark at about 25°C to incubate for eight weeks. Incubated soil samples were collected at second, fourth, sixth and eight week for routine chemical analysis.

Soil samples were air dried and passed through 2mm-sieve. Total soil N was determined by micro-kjeldahl method and organic matter by Walkley-Black wet oxidation method[6] Exchangeable K, Na, Ca and Mg were extracted with neutral 1M ammonium acetate, K and Na were determined with flame photometer while Ca and Mg were determined by versenate (EDTA) titration method. Available P was determined by colorimetry after Bray-1 extraction[7]. The soil pH was measured by glass electrode in a 1:1 soil water suspension[8], Cation Exchange Capacity (CEC) was determined by ammonium saturation method[9] and Exchange Acidity (EA) determined by KCl extraction method[10]. The result were subjected to analysis of variance and means separated using least significant difference at p=0.05.

RESULTS AND DISCUSSION

Table 1 and 2 show that incubation of soil with poultry and cattle manure for eight week on clay soil lead to increases in soil pH, OC, N, P, K, Ca, Mg, Na and CEC and decrease in EA, the value of the soil chemical properties increased with amount of manure from 0 to 60 g kg^{-1} and EA decreased accordingly. The changes in clay soil chemical properties given by 60 g kg^{-1} were significant (p>0.05) for both poultry and cattle dung. Significant differences existed between control and 20 kg^{-1} poultry manure in pH, OC, N, P, K, CEC, Mg, EA

Table 1: Effect of poultry dung on clay soil

Treatment level (g kg^{-1})	pH	O.C (g kg^{-1})	N (g kg^{-1})	P (ppm)	K (cmol kg^{-1})	Ca (cmol kg^{-1})	Mg (cmol kg^{-1})	Na (cmol kg^{-1})	CEC (cmol kg^{-1})	EA (cmol kg^{-1})
0	6.85	0.67	0.14	2.57	0.36	3.15	1.45	0.34	5.20	1.80
20	7.14	1.32	0.19	5.45	0.83	3.50	1.92	0.42	6.80	1.40
40	7.34	1.35	0.19	8.31	1.09	3.78	2.95	0.48	7.83	1.30
60	7.44	1.61	0.21	9.66	1.35	3.88	2.98	0.64	9.08	1.00
LSD (0.05)	0.19	0.57	0.04	2.75	0.33	0.85	1.21	0.20	1.40	0.28

Table 2: Effect of cattle manure on clay soil

Treatment level (g kg^{-1})	pH	O.C (g kg^{-1})	N (g kg^{-1})	P (ppm)	K (cmol kg^{-1})	Ca (cmol kg^{-1})	Mg (cmol kg^{-1})	Na (cmol kg^{-1})	CEC (cmol kg^{-1})	EA (cmol kg^{-1})
0	6.81	0.34	0.03	0.93	0.30	1.97	1.23	0.48	4.43	2.10
20	7.02	0.55	0.05	1.90	0.58	2.60	1.68	0.46	5.67	1.80
40	7.33	0.89	0.07	3.66	0.67	3.15	2.60	0.57	7.37	1.70
60	7.47	1.46	0.12	5.95	0.94	4.45	2.65	0.85	7.87	1.20
LSD (0.05)	0.31	0.44	0.04	2.09	0.25	1.30	0.48	0.30	1.37	0.43

Table 3: Effect of poultry dung on sandy clay loam

Treatment level (g kg^{-1})	pH	O.C (g kg^{-1})	N (g kg^{-1})	P (ppm)	K (cmol kg^{-1})	Ca (cmol kg^{-1})	Mg (cmol kg^{-1})	Na (cmol kg^{-1})	CEC (cmol kg^{-1})	EA (cmol kg^{-1})
0	7.06	2.17	0.11	6.40	0.16	2.38	1.00	0.33	5.28	0.16
20	7.46	3.18	0.16	6.76	0.30	3.18	1.88	0.38	6.38	0.16
40	7.59	3.31	0.17	6.94	0.39	3.40	1.90	0.39	6.98	0.13
60	7.69	4.05	0.21	7.41	0.50	3.65	2.15	0.40	7.10	0.11
LSd (0.05)	0.27	1.19	0.06	0.90	0.12	0.55	0.65	0.05	1.01	0.04

Table 4: Effect of cattle manure on sandy clay loam

Treatment level (g kg^{-1})	pH	O.C (g kg^{-1})	N (g kg^{-1})	P (ppm)	K (cmol kg^{-1})	Ca (cmol kg^{-1})	Mg (cmol kg^{-1})	Na (cmol kg^{-1})	CEC (cmol kg^{-1})	EA (cmol kg^{-1})
0	7.27	2.26	0.12	6.83	0.19	2.60	1.03	0.33	6.68	0.11
20	7.56	2.84	0.15	7.16	0.33	2.73	1.18	0.34	7.08	0.10
40	7.48	3.01	0.16	7.21	0.40	2.80	1.73	0.34	7.58	0.10
60	7.77	3.82	0.20	7.72	0.47	3.18	1.75	0.36	7.90	0.08
LSD (0.05)	0.48	0.52	0.06	0.65	0.14	0.40	0.44	0.04	0.87	0.04

but not in Ca and Na. There were no significant difference between control and 20 kg^{-1} for cattle manure except with respect to K. Clay was therefore revealed to respond faster to poultry manure amendment compared with that of cattle manure, this can be related to higher value of P, Ca and Mg recorded for poultry manure in literature[11]. Significant differences ($p>0.05$) occurred in EA between control and 20, 40 and 60 g kg^{-1} poultry manure but it was 60 g kg^{-1}cattle manure that reduces EA significantly in clay soil.

Table 3 and 4 show soil chemical properties of sandy clay loam soil as affected poultry and cattle manure incubation for eight week. Soil incubation lead to an increase in pH, O.C, N, P, K, Ca, Mg, Na and CEC and decrease in EA. There were significance difference ($p>0.05$) between control and 60 g kg^{-1} treatments for poultry dung and cattle manure. Value of soil properties also increased with amount of manure from 0 to 60 g kg^{-1}. Poultry manure at 60 reduces EA significantly, but there were no significant differences in cattle manure treatments EA on sandy clay loam. Differences between control and 20 g kg^{-1} were not significant for most chemical properties in poultry and cattle manure on sandy clay loam except with regard to pH and Mg for poultry manure and O.C for cattle manure, response of sandy clay loam to poultry dung and cattle manure was therefore not as fast as that of poultry dung on clay soil. Irrespective of soil type, soils that had poultry manure had higher value of O.C and N than soil that had cattle manure. Comparative analysis of different animal manure[11] showed that poultry manure had higher N value (11.95%) compare with cow dung (4.16%). in case of sandy clay loam soil, poultry manure incubated soil also had higher Ca, Mg and Na concentration. The better effect of poultry manure on soil chemical properties compared with cattle manure could also be adduced to lower C:N and C:P ratios recorded for poultry manure in previous study[12], the lower C:N and C:P ratio suggest superior mineralization of organic nutrients in poultry manure compared with cattle manure. Manure general is known to have positive influence on soil type[13-14].

CONCLUSIONS

It is concluded that poultry and cattle manure improved soil chemical properties irrespective of soil type

(texture), poultry manure improved soil chemical properties more than cattle manure especially as regards the organic carbon and N status. Clay soil responded more quickly to manure than sandy clay loam.

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