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PHYSICO - CHEMICAL PROPERTIES OF SEMI - ARID SOILS INCUBATED WITH DIFFERENT SOURCES OF ORGANIC MANURES

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Laboratory studies were conducted with five soils of varied textural classes treated with different sources of organic manures, viz. farmyard, poultry and swine manures at the rate of 15 tons/ha for a period of 4 months. Analyses of the incubated soils showed that the application of organic manures significantly increased the contents of total and available N and available P in all the soils studied. A significantly higher release of plant nutrients was recorded in soils treated with swine manure followed by poultry and farmyard manures. Application of farmyard manure (FYM) significantly increased the organic carbon content and cation exchange capacity of the soils more than poultry and swine manures. Water holding capacity was also increased significantly in all textural classes except in the sandy loam. In general, addition of the organic manures significantly improved the physico-chemical properties of the soils.

Application of organic manures to soil, apart from improving the physical properties, enhances the availability of nutrients, increases the organic carbon and cation exchange capacity of soils and provides an optimum soil environment to increase crop yields. The quantum of fertilizers applied to the soil has phenomenally increased due to the advent of high yielding crop varieties. Frequent and higher application of fertilizers is bound to have deleterious effects on the physico-chemical properties of the soil, unless adequate amount of organic manures are added to counteract such effects. The role of organic manures as a source of plant nutrients, as a stabilizer of soil structure and as an important contributor to the cation exchange capacity of savanna soils had been demonstrated by Jones and Wild (1976). Studies carrted out for several years by Pichot (1975) have shown the importance of organic manures in maintaining soil fertility and has led to the search for techniques aiming at increasing and stabilizing the organic matter content of cultivated soils in the tropics.

Different sources of organic manures differ in their physico-chemical characteristics and nutrient releasing capacity. The variable nutrient contents of these manures will affect the quantum of nutrients released to the soil after their application. Also, due to the variability of their physical

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characteristics, they are bound to affect the physical properties of soils such as porosity, water holding capacity and structural indices (Muthuvel *et al.*, 1982). Generally, the soils of Borno State of Northern Nigeria are sandy and low in organic matter content and some plant nutrients. Information on the effect of organic manures on these soils is scanty. The objective of the present investigation, therefore, was to study the influence of different source of organic manures on the physico-chemical characteristics of soils of different textural classes.

MATERIAL AND METHODS

Five surface (0-15cm) soil samples were collected from different locations in Borno State of Northern Nigeria representing major textural classes viz. sandy loam, clay, sandy clay loam, silty clay loam and clay loam. These soils were collected from University Farm (S1), Ngala (S2), Mafa (S3), Dikwa (S4) and Limankara (S5), respectively The physico-chemical properties of these soils are shown in Table 1. Three types of organic manures namely farmyard, poultry and swine manures were collected and analysed (Table 2). Five hundred grams of soil samples of each textural class were put in glass beakers and treated with different sources of organic manures at the rate 15 tones/ha in two replications. The soils were incubated at room temperature (apdroximately 30°C) for 4 months. Constant moisture level was maintained at about 30 per cent, roughly corresponding to field capacity by weighing the beakers containing the soil every two day interval and adding distilled water to replenish the evaporation loss.

The details of treatments were as follows :

T1, Control (no manure added)
T2, Farmyard manure
T3, Poultry manure and
T4, Swine manure

After the incubation period, soil samples were analysed for total and available N, available P, organic carbon content, cation exchange capacity, water holding capacity and porosity. Routine analytical procedures were adopted for the various analyses.

RESULTS AND DISCUSSION

Preliminary analyses of soil samples and organic manures :

The results of the preliminary analyses of the soil samples are shown in Table 1. The texture of the soils varied from sandy loam to clay, with clay content ranging from 10 to 67 per cent. The pH and electrical conductivity ranged from 6.80 to 7.98 and 0.085 to 0.151 mmhos/cm, respectively. Among the soil samples collected, the clay loam soil from Limankara had maximum contents of organic carbon (0.77 per cent), total N (0.15 per cent), available N (394 ppm) and C:N ratio (4.97). Generally, the C:N ratios of these soil samples are narrow due to the rapid oxidation of organic matter under the prevailing

TABLE 1. Physico-chemical Properties of soils used for incubation study

Characteristics	Soils S1	S2	S3	S4	S5
pH 1:2.5 H_2O	6.80	7 98	6.92	7.08	6.95
E. C. (mmhos/cm)	0.085	0.151	0.071	0 138	0.099
Organic carbon (per cent)	0.416	0.486	0.148	0.353	0.766
Total N (per cent	0.089	0.115	0.067	0.092	0.154
Available N (ppm	55	368	219	215	394
Available P (ppm	5.10	6.35	4.82	5.19	6.75
Cation exchange capacity (me/100g	7.04	17.20	10.49	11.25	9.12
Total exchangeable bases (me/100g)	5.06	15.23	7.69	9.39	7.20
Base saturation (per cent)	71.9	88.6	73.3	83.5	78.9
Particle size distribution (per cent) Sand	73.0	8.0	79.0	14.0	35.0
Silt	17.0	25.0	5.0	55.0	35.0
Clay	10.0	67.0	16.0	31.0	30.0
Textural class	Sandy Loam	Clay	Sandy Clay Loam	Silty Clay Loam	Clay Loam
Maximum water holding capacity (per cent)	28.4	46.3	31.2	38.8	36.5
Pore space (per cent)	47.2	52.2	45.3	40.1	50 2

TABLE 2. Chemical composition of organic manures used for Incubation study

Properties	Farmyard manure	Poultry manure	Swine manure
Moisture (per cent)	9.30	8.92	3.24
Total N (per cent)	1.10	1.21	2.15
Organic carbon (per cent)	24.82	18.94	15.22
C : N ratio	20.68	18.75	7.05
Total P_2O_5 (per cent)	0.68	1.78	2.55
pH	7.12	6.68	6.90
(E C mmhos/cm)	0 050	0.034	0.048

conditions of the savanna region of Northern Nigeria (Adebayo and Akaeze, 1976). The contents of total and available N were also low as reported by Jones (1973) for savanna soils. Maximum clay content was recorded in the clay soils from Ngala and this accounted for the high CEC, exchangeable bases and water holding capacity. The profound influence of clay especially montmorillonite on the physico-chemical properties of soils was

also reported by Somani (1978). Analyses of the different sources of organic manures used in this study revealed that maximum contents of total N and P was recorded in swine manure (Table-2). However,the organic carbon content was highest in FYM, followed by poultry and swine manures. This is probably due to the variation in feed rations of the animals.

TREATMENT EFFECTS

Total and available N:

In general, total N content increased significantly with the application of organic manures as compared to the control (Table 3). The per cent increase over the control in the soil from the University Farm was 102.1 78.9 and 66.8 with swine, poultry

TABLE 3. Physico-Chemical properties of soils incubated with different sources of organic manures (mean of 2 replications)

Properties	Treat ments	Soils S1	S2	S3	S4	S5
Total N (per cent)	T1	0.090b	0.118c	0.066d	0.092c	0.165c
	T2	0.150a	0.144bc	0.129c	0.156d	0.194bc
	T3	0.161a	0.161ab	0.157b	0.169a	0.218ab
	T4	0.182a	0.188a	0.182a	0.178a	0.241a
SEd.		0.010	0.009	0.002	0.006	0.011
C. D. O. 05		0.033	0.030	0.005	0.019	0.034
Organic Carbon (per cent)	T1	0.274	0.461	0.133b	0.316c	0.747
	T2	0.366	0.492	0.261a	0.425a	0.863
	T3	0.243	0.453	0.227a	0.420a	0.818
	T4	0.293	0.401	0.140b	0.349b	0.766
SEd.		0.036	0.029	0.012	0.005	0.053
C. D. O. 05		NS	NS	0.037	0.015	NS
Available N (ppm)	T1	212d	275d	200d	201c	299d
	T2	275c	399c	318b	348b	512c
	T3	305b	440b	371b	397ab	562b
	T4	404a	516a	425a	418a	682a
SEd.		2.47	4.62	6.15	19.82	10.07
C. D. O. 05		7.85	14.71	19.57	63.06	32.05
Available P (ppm)	T1	4.87d	5.19c	3.82d	4.66d	5.31d
	T2	5.78c	6.89b	5.38c	5.82c	7.11c
	T3	6.12b	7.02ab	5.90b	6.62b	7.73b
	T4	8.22a	7.21a	6.78a	7.00a	8.28a
SEd.		0.09	0.13	0.09	0.08	0.15
C. D. O. 05		0.29	0.40	0.28	0.28	0.49
Cation exchange capacity (me/100g)	T1	6.14c	14.82b	9.08d	10.08d	8.05d
	T2	8.13a	19.67a	13.02a	14.03a	12.31a
	T3	7.18b	17.25ab	11.20b	11.97b	10.93b
	T4	7.15b	17.99a	10.22c	11.21c	9.63c

SEd.		0.16	0.80	0 28	0.16	0.52
C. D. O. 05		0.52	2.55	0.91	0.49	1.65
Water holding capacity (me/100g	T1	25.63c	42.13c	28.13	34.58c	32.54c
	T2	34.05a	58.69a	36.23	44.53a	37.70a
	T3	29.89b	46.07b	32.77	40.74b	36.04b
	T4	27.89bc	46.01b	32.09	37.44bc	34.46bc
SEd.		1.17	3.08	1.81	1.22	0.88
C. D. O. 05		3.72	9.81	NS	3.89	2.80
Pore space (per cent)	T1	44.27b	48.73c	41.49c	38.04c	47.73
	T2	54.74a	55.89a	49.10a	45.60a	52.95
	T3	47.05b	53.71ab	47.19ab	42.99b	50.32
	T4	45.27b	51.88b	43.70bc	40.75b	51.20
SEd.		1.34	0.88	1.05	0.88	1.14
C. D. O. 05		3.61	2.83	3 35	2.57	NS

NS : Not Significant

Means followed by the same letters are not significantly different at the 5 per cent probability level by Duncan's Multiple Range Test.

and farmyard manures, respectively. The results also revealed that the sandy clay loam soil from Mafa showed significantly higher total N with the addition of organic manures than its counterparts. It was evident that the addition of swine manure contributed significantly towards total N content followed by poultry and farmyard manures, which might be due to the higher content of total N in the swine feed rations. As in the case of total N, available N was also significantly increased by the addition of organic manures when compared to the control. However, the highest value (127.8 per cent) was recorded in the clay loam soil from Limankara, with reference to per cent increase over the control. Apparently, the addition of swine manure was also responsible for the high content of available N in all the soils studied. The correlation coefficients between different variables are presented in Table 4. Highly significant positive correlations were observed between total and available N. The increase in total and available N in the soils as a result of the addition of organic manures indicated that the N present in the manures may be readily available to the crops as reported by Pandalai *et al.* (1958).

Organic carbon and available P:

The addition of different types of organic manures did not significantly influence the organic carbon content of the soils except the sandy and silty clay loams. The FYM and poultry manures significantly increased the organic carbon when compared to swine manure and the control. Apparently, this effect might be due to the high amount of organic carbon in the farmyard and poultry manures. A comparison of the mean available P contents indicated that all treatments had

significantly higher values than the control in all the soils studied. The maximum amount of available P was observed from swine monure-treated soils followed by poultry and farmyard manures. The sandy clay loam from Mafa had the highest amount of available P followed by the soils from University Farm, Limankara, Dikwa and Ngala. Ravikumar and Krishnamoorthy (1980) have also observed that the application of poultry and farmyard manures increased the total and available N and P cantents in soils. The increase in available P cantent of the soils was evidently due to the high P content of the original material and also, probably due to the solubilization of insoluble forms of P by organic acids producted during the decomposition of organic matter present in the manures, as suggested by Singh and Lal (1976) and, Indiraraja and Raj (1979).

Cation exchange capacity :

The CEC of the soils incubated with different organic manures was significantly influenced. Addition of FYM proved to be highly effective in improving the CEC of the soils than the others (Table 3). Soils from Mafa, Dikwa and Limankara had significantly high CEC values as a result of FYM addition, followed by poultry and swine manures. However, the incorporation of organic manures in the soil of Ngala did not affect the CEC, whereas the effects of poultry and swine manures were at par but significantly higher over the control in the soil from University Farm. The profound influence of organic manures on CEC of the soils is in agreement with the previously reported results (Jones and Wild, 1975; Ghonsikar and Musande, 1977). A linear relationship between CEC and organic carbon was observed in soils from Mafa, Dikwa and Limankara (Table 4).

Water holding capacity and porosity:

The water holding capasity was significantly increased with the addition of organic manures in all except the soil from Mafa. Maximum increase in water holding capacity was recorded in treatments with FYM, followed

TABLE 4. Correlation coefficients between different variable

Variables	r values S1	S2	S3	S4	S5
Total N vs available N	0.89**	0.95**	0.99**	0.98**	0.94**
Cation exchange capacity vs Organic carbon	NS 0.58	NS 0.47	0.92**	0.86**	0.64**
Water holding capacity vs Porosity	0.90**	0.85**	0.91**	0.97**	0.85**

* Significant at 5 per cent level
** Significant at 1 per cent level
NS Not Significant

by poultry and swine manures. This effect was most pronounced in soils from Ngala, followed by University Farm, Mafa, Dikwa and Limankara. The striking effect of FYM on water holding capacity might be due to the build up of organic matter in the soils as observed by Azzam (1963). Porosity of soils was also influenced by the addition of organic manures. This effect was significant in all except the clay loam soil from Limankara. Here again, FYM exerted a marked influence on these parameters more than other types of manures. The improvement in the physical properties of soils by the addition of organic manures might be through improvement in the organic matter build up as reported by Muthuvel *et al.* (1982). Highly significant positive correlations were observed between water holding capacity and porosity (Table 4). Favourable effects of FYM application in building up of soil structure were also reported by several workers (Biswas *et al.* 1969; and Kanwar and Prihar, 1962).

The results observed in the present investigation suggest that the fertility of the soils of savanna region of Northern Nigeria could be improved by the addition of organic manures. It was also evident that the addition of organic manures influenced the physical properties of soils, like water holding capacity and porosity of both sandy and clayey soils.

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GENETIC ANALYSIS OF GRAIN SIZE AND OTHER CHARACTERS OF SORGHUM

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Six genotypes of sorghum were crossed in half diallel fashion. Combining ability analysis indicated that E35-1 was a desirable combiner for days to 50% bloom, grain yield and 1000-grain weight. E35-1 x Vidisha 60-1 and E35-1 x GJ 108 were identified as desirable crosse for grain yield and 1000 - grain weight respectively.

Recently released sorghum hybrids and varieties in India are significantly superior than the indigenous varieties for grain yield. Bold and lustrous grain get a premium in market. Indigenous varieties have bolder grains than the high yielding varieties. Hence, there is a need to incorporate boldness of grains in the forthcoming varieties. Present investigation was aimed to identify parental lines which could act as desirable combiners for grain size coupled with grain yield and some of the agronomic attributes.

MATERIALS AND METHODS

In the rainy season of 1980, six genotypes of sorghum were crossed in all possible ways except reciprocals. Vidisha 60-1 and E35-1 are bold grained, tall statured indigenous cultivars from Madhya Pradesh and Ethiopia

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