REFERENCES

HUSSIAN, T. and JILANI, G. (1989). Synergistic effect of organic manure and N fertilizer on irrigated rice IRRN 14 (2) : 27.

KAVIMANI, R. and RAJESEKARAN, R. (1991). Effect of urea super granules on rice yield. Madras Agric. J. 78 (9-12): 495.

KHIND, C. S., MEELU O.P and VIRAJ BERI (1992). Efficiency of green manures substituted for applied nitrogen in rice. IRRN. 7(4) : 20.

SENAPATI, H. K. (1986). Azolla as a substitute for N fertilizer in rice cultivation. IRRN. 11(1) : 30-31.

SHANMUGAM. A. (1983). Studies on azolla as partial substitute for nitrogen in lowland rice. M. Sc. (Ag.) Thesis. TNAU, coimbatore.

SONI, P.N. and RAJINDER KAUR. (1989). Efficiency of slow release fertilizers in rice based cropping systems. Indian J.Agron. 34(2) : 185-191.

(Received: November : 1999 Revised : May 2000)

Madras Agric. J., 86(10-12): 546-549 October - December 1999
https://doi.org/10.29321/MAJ.10.A00653

PHYSICAL CHANGES INDUCED BY MINERAL, ORGANIC AND INDUSTRIAL AMENDMENTS ON A VERTISOL AND ITS EFFECT ON YIELD OF FINGER MILLET (*ELEUSINE CORACANA GEARTN.)*

K.K. MATHAN

Department of Soil Science and Agricultural Chemistry
Tamil Nadu Agricultural University, Coimbatore-641 003.

ABSTRACT

Application of soil amendments apart from improving the soil physical properties also gave higher yields of finger millet. The efficacy of amendments may be graded as follows: organic amendments > industrial wastes > mineral wastes. Within the above group the order of efficacy in each group was as follows: 1) Organics : Poultry manure > farm yard manure > maize straw > cotton waste. 2) Industrial Wastes: Lime sludge > furnace slag > cement dust. 3) Mineral amendments : Gypsum > magnesite> tank silt. Incorporation of amendments resulted in significant reduction in bulk density and soil strength, and increase in hydraulic conductivity, stability index, aggregate stability and available water content.

KEY WORDS: Mineral industrial and organic wastes –Soil physical properties- Ragi (*Eleusine Coracana*)

Application of soil amendments restores the physical conditions of degraded tropical soils. Different types of crop and animal residues, organic and inorganic wastes were used as amendments to improve soil physical properties (Nuttal,1970; Moagwa, 1992). Adequate information on the utilization of industrial wastes as amendments and their relative efficiency as against organic and mineral amendments is not available. Hence the present study was undertaken to evaluate the influence of applying agricultural, industrial and mineral wastes as amendments to improve the physical properties of black soil and the yield of finger millet.

MATERIALS AND METHODS

A field experiment with finger millet as the test crop was laid out in a Vertisol (Typic chromustert) of silty clay loam texture.

Following were the treatments: Main plot treatments : T_1 – Farm Yard manure (FYM); T_2- Maize straw (MS); T_3- Poultry manure (PM); T_4- Cotton waste compost (CEC); T_5- Tank silt (TS); T_6 – Gypsum; T_7-Magnesite; T_8- Furnace slag (FS); T_9-Cement dust (CD); T_{10}-Lime slag and T_{11}- Control. Treatments 1 to 5 were applied at 25 t ha^{-1} and T6-T10 were added at 10 t ha^{-1}. The amendments were well incorporated into the soil 30 days before transplanting. Sub-plot treatments; F_0 – Amendments alone; and F_1 – Amendments with recommended dosage of fertiliser (N : P_2O_5 : K_2O at 95 : 45 : 45: 22.5 kg ha^{-1}). The treatments were replicated thrice in a split-plot design.

Pre-planting and post-harvest soil samples cores of 75 mm dia and 75 mm height were collected at 0-20 cm depth. Dry bulk density was estimated by using the method of Black (1965). Volumetric

Table 1. Physical properties of experimental soil

Clay (%)	30.2
Silt (%)	26.1
Sand (%)	42.3
Bulk density (Mg m^{3})	1.3
Aggregate stability (%)	25.2
Stability index	18.1
Mean weight diameter (mm)	0.2
33 KPa moisture (%)	27.8
1500 KPa moisture (%)	17.0
Hydraulic conductivity (cm hr^{-1})	0.4

moisture retained at-33 Kpa and –1500 Kpa matric potential were estimated using pressure plate apparatus. Available water was taken as the difference between –33 and –15 Kpa moisture) contents. Saturated hydraulic conductivity (K (sat)), was determined using constant head technique (Gupta and Dakshinamurthi, 1981). Correlations were worked out between the physical properties and yield of finger millet.

RESULTS AND DISCUSSION

The physical properties of the experimental soil are furnished in Table 1. The saturated hydraulic conductivity, aggregate stability, stability index of the soil were low.

Amendments significantly reduced the bulk density of the soil from 1.30 Mg m^{-3} to less than 1.24 Mg m^{-3}. Maize straw and farm yard manure were on par and superior to the mineral amendments viz., cement dust (T_9), magnesite (T_7) and furnace slag (T_8) which were on par (Table 2).

In general, organic amendments (PM, FYM, MS and CWS) registered higher K (sat) than inorganic amendments. The aggregate stability of soil was significantly improved by the addition of organic amendments such as FYM, MS and PM and industrial amendments such as furnace slag and lime. Gypsum and furnace slag treatments were equally effective as organics, and in this respect they were similar to poultry manure in improving the mean weight diameter of the soil.

The field capacity moisture (-33 Kpa) was 27.4 per cent in the control plot and amendment applied plots registered significantly higher amounts which

Table 2. Physical properties of post-harvest soils

Treatments	Bulk density (Mg m^{-3})	Hydraulic conductivity (cm hr^{-1})	Aggregate stability (%)	Stability index	Mean weight diameter (mm)
T_1 - Farm yard manure	1.06	0.8	42.8	28.7	0.46
T_2 - Maize straw	1.04	1.1	44.2	34.5	0.44
T_3 - Poultry manure	1.10	1.0	44.6	35.4	0.56
T_4 - Cotton waste compost	1.11	0.5	42.3	27.6	0.41
T_5 - Tank silt	1.12	0.4	38.8	26.0	0.40
T_6 - Gypsum	1.14	0.8	40.2	26.7	0.50
T_7 - Magnesite	1.17	0.4	38.5	26.0	0.43
T_8 - Furnace slag	1.17	0.7	43.2	31.5	0.56
T_9 - Cement dust	1.24	0.6	42.8	30.3	0.41
T_{10} - Lime slag	1.13	0.6	43.6	33.0	0.46
T_{11} - Control	1.30	0.4	28.7	22.5	0.38
LSD (P=0.05)	0.04	0.3	1.1	1.3	0.01

Table 3. Available water and yield of ragi (CO 10) at harvest

Treatments	Moisture (%)			Yield (t/ha)	
	— 33 KPa	— 1500 KPa	Available water	Grain	Straw
T_1 - Farm yard manure	31.8	17.3	14.5	2.5	3.0
T_2 - Maize straw	31.5	17.5	14.0	2.2	2.8
T_3 - Poultry manure	34.9	18.8	16.1	2.9	3.5
T_4 - Cotton waste 2.5	compost	30.2	17.9	12.3	2.1
T_5 - Tank silt	29.7	18.7	11.0	2.2	2.7
T_6 - Gypsum	31.5	18.2	13.3	2.2	2.8
T_7 - Magnesite	30.5	18.3	12.2	2.1	2.7
T_8 - Furnace slag	33.7	17.8	15.9	2.3	2.6
T_9 - Cement dust	30.0	17.1	12.9	2.1	2.6
T_{10} - Lime slag	31.3	17.4	13.9	2.6	3.0
T_{11} - Control	27.4	17.0	10.4	1.7	2.0
LSD (P=0.05)	0.8	0.6	3.0	0.3	0.3

ranged from 29.7 and 34.9 per cent (Table 3). Similar trend was noted in -1500 Kpa moisture. Consequently the available water content in the treated plots especially treated with FYM,MS,PM and furnace slag was significantly higher than the control plots. Improvement in the available water content and hydraulic conductivity and significant reduction in the bulk density coupled with improvement in the aggregate stability and the stability index resulted in more than 23.5 per cent increase higher yields than the control.

The aggregate stability was observed to be positively correlated with the yield of grains (r = 0.730*) and straw (r = 0.742*). Biswas and Khosla (1971) reported significant positive correlations between aggregates above 0.25 mm and yield of maize. This relationship may be due to the favourable influence of amendments in improving the structural properties of soil. The hydraulic conductivity was negatively correlated with bulk density (r = - 0.615*) which is in accordance with the findings of Ramamohana Rao et al. (1973). The available water was positively correlated with stability index (r = 0.824*) which agrees with the findings of Biswas and Ali (1967). Straw yield showed that poultry manure treatment was superior to farm yard manure; lime sludge and maize which were on par.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the facilities provided for the evaluation of the above project work by the Tamil Nadu Agricultural University and the Indian Council of Agricultural Research.

REFERENCES

BISWAS, T.D. and ALI, M.A. (1967). Influence of organic carbon and clay content of soil on permanent wilting point percentage. **Indian J.Agric.Sci. 37**: 322-30.

BISWAS, T.D. and KHOSLA,B.K. (1971). Building up of organic matter status of the soils and its relation to the soil physical properties. International Symposium on **Soil Fertility Evaluation.Proc.** 1: 831-42.

BLACK, C.A. (1965). Bulk density. In **Methods of Soil Analysis.** Part. I .ed. C.A. Black et al., American Society of Agronomy, Madison, WI, pp.374-90.

GUPTA, R. P. and DAKSHINAMURTHI, C.(1981). **Procedures for physical Analysis of Soils.** IARI, New Delhi Publn.

MOAGWA,J.S.C. (1992). Improving the productivity of a degraded Ultisol in Nigeria using organic and inorganic amendments. Para 2. Changes in physical properties **Bioresource Technology 42** : 167-75.

NUTTAL, W.F. (1970). Effect of organic amendments on some physical properties of Luvisolic soils in relations to emergence of rapeseed in a growth chamber. Can. J. Soil Sci. 50 : 397-402.

RAMAMOHANA RAO, M .S., RAO, Y.N. and KATHAVADE, Y.V. (1973). Effect of compaction of the physical properties of soils and yield of wheat and uptake of nutrients by tomato. Indian J. Agric. Sci. 43 : 273-75.

(Received : March 1999 Revised : May 2000)

Madras Agric. J., 86 (10-12): 549-551 October - December 1999

EFFECT OF NATURAL FOREST ON THE CHEMICAL PROPERTIES OF SOILS

BALAMUARUGAN, K. KUMARASWAMY and A. RAJARAJAN

Department of Soil Science and Agricultural Chemistry,
Agricultural College and Research Institute,
Madurai-625 104.

ABSTRACT

The effects of natural forest on the chemical properties of soil at different depths (0 to 30, 30 to 60 and 60 to 90 cm) were studied. There was a slight increase in pH in the sites under vegetation compared to open space, whereas no appreciable change in EC was observed. But substantial increase in cation exchange capacity, organic carbon content, total and available primary nutrients were recorded in the sites under vegetation compared to the contents in the open space. The effect of natural forest was more in surface soil (0 to 30cm) than in subsurface soil (30 to 60 and 60 to 90cm). The underwood vegetation in the study area, leaf litter production over the period of establishment and nutrient concentration in leaf litter were also recorded.

Tree plantations improve soil chemical properties through addition of leaf litter. The effects on soil chemical properties differ with the kind of vegetation the soil supports (Yadav, 1968). Mongia and Bandyopadhyay (1994) reported higher organic carbon content under natural forest than under paddock, rubber, teak and red oil palm. The high carbon content of soil under tree plantations was due to highest litter fall (Hosur and Dasog, 1995). Singh *et al.*,(1985) observed that soil under *Cryptomeria japonica* had maximumCEC than the soil under mixed and *Pinus* species plantation. Information on effect of tree vegetations on the soil properties in Tamil Nadu is scanty. This study was, therefore, undertaken to understand the changes in chemical properties in relation to natural forest in Madurai District of Tamil Nadu.

MATERIALS AND METHODS

The study area selected for present investigation was Alagarkovil natural forest. The latitude of the study site was 9°54' N and the longtitude was 78°54' E. Soil samples were collected from two profiles in open space and two profiles under vegetated area. In each profile, soil samples were collected from three different depths of 0 to30, 30 to 60 and 60 to 90 cm. The salient site

Table 1. Study site characteristics of soil profiles under natural forest

Particulars	Study site characters
Forest division	Trichirappalli
Forest range	Alagarkovil
Soil group	Red lateritic
Soil depth	Shallow
Mode of soil formation	Primary
Parent material	Granite
Topography	Hill slope
Slope	20
Aspects	Western
Erosion	Very severe
Ground water	Deep (>5m)
Drainage	Excessive
Climate	Subtropical
Soil order	Alfisol