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Impact of biological wastes on soil physical properties and yield of maize and finger millet

K.K. MATHAN
Dept. of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore - 641 003

Abstract : Two field trials were conducted in red sandy loam soils with finger millet (*Eleusine corecana* Geartn. var. Co 10) and maize (*Zea mays* var. Ganga-1) as test crops to evaluate the influence of biological wastes on the soil physical properties and the yield of crops. The biological wastes tried were maize straw, pig manure, municipal compost, sugarcane bagasse and groundnut husk applied at 20 t ha^{-1}. In both the trials, organic wastes application increased the saturated hydraulic conductivity and aggregate stability significantly. Significantly higher grain and straw yield over control obtained in pig manure and municipal compost treated plots. (*Key Words* : *Biological wastes, Soil physical properties, Maize, finger millet*).

The importance of organic matter in influencing the physico-chemical and biological properties of soils need no emphasis. The application of organic farm wastes like maize straw, rice straw and cotton waste compost have been reported to improve the physical properties of soils besides increasing the crop yield (Mali, 1997 and Sathyanarayana *et al.* 1973). Application of chopped maize straw increased the yield of cereal crops and physical properties of chernozem soil (Hepp, 1965). K (sat) in the tillage pan was higher only where residue additions were increased (Pikul and Ilimorras, 1986). Sorghum straw incorporation improved the porosity of the plough layer (Schijonning, 1985). Informations on the influence of ragi straw, pig manures, municipal composts, sugarcane bagasse, groundnut husk, on the physical properties of soils are inadequate. Hence the present study was taken up.

Materials and Methods

Two field experiments were laid out simulataneouly with different organic farm wastes in red sandy loam soils in randomised block design and replicated four times. The treatments were T_1 - Maize straw; T_2 - Pig manure; T_3 - Municipal compost; T_4 - Sugarcane bagasse; T_5 - Groundnut husk; T_6 - Control. Finger millet (var. Co 10) and maize (var. Ganga-5) were the test crops for the first and second experiments respectively.

Organic waste materials were spread on soil surface and incorporated into the soil for finger millet 90 kg N, 45 kg P_2O_5 and 22.5 kg K_2O per hectare were applied. For maize, 135 kg N, 68 kg P_2O_5 and 45 kg K_2O ha were applied. For both the trials NPK were applied in the form of ammonium sulphate, superphosphate and muriate of potash respectively. Phosphorus and potassium were applied as basal dressing while nitrogen was applied in split doses *viz.*, half at planting and the rest 45 days after planting.

Post harvest soil cores (75 mm dia and 75 mm height) were collected and analysed for saturated hydraulic conductivity, total and non-capillary porosities, aggregate stability and stability index by the standard methods of analysis (Gupta and Dakshinamoorthy, 1981). The grain and straw yield were recorded. The data were statistically analysed and the results are discussed.

Results and Discussion

The physical properties of soils of finger millet fields at harvest are furnished in Table 1. Organic wastes incorporation had significantly higher saturated conductivity (K sat). The different organic wastes were statistically comparable among themselves. Pagliai *et al.* (1981) reported that addition of organic wastes increased soil porosity and modified the pore size distribution pattern. In the second experiment, addition of organic wastes except groundnut husk (T_5) increased the K (sat) values significantly higher than pig manure (T_2) and municipal compost (T_3) which were on a par. This was in line with the observation of Pikul and Ilimorras (1986).

In the first experiment with finger millet, the total porosity was increased significantly over control only in T_3, while in others though there was increase in total porosity over control, these did not attain statistical significance. In the second trial with maize, the treatment effect on total porosity was not significant. Thus the response was different for different test crops. This was in line with the observations of Skidmore *et al.* (1986).

Table 1. Physical properties and yield of finger millet crop (Mean of 4 replications)

S. No.	Trials	K (sat) (cm hr^{-1})	T.P. (%)	NCP (%)	A.S. (%)	Yield (t ha^{-1})	
						Grain	Straw
1	Maize straw	9.5	48.5	14.6	21.7	3.75	4.08
2	Pig manure	8.0	52.9	12.5	35.9	4.25	6.00
3	Municipal compost	7.9	60.6	16.8	44.8	3.87	4.97
4	Sugarcane bagasse	8.5	43.7	15.8	29.3	3.58	4.30
5	Groundnut husk	7.3	47.3	15.4	25.5	3.58	4.33
6	Control	5.4	46.2	13.8	20.2	3.10	3.75
	CD (P=0.05)	2.4	11.3	2.4	8.8	0.69	1.18

TP = Total porosity NCP = Non-capillary porosity
A.S. = Aggregate stability K (sat) = Saturated hydraulic conductivity

Table 2. Physical properties and yield of maize crop (Mean of 4 replications)

S. No.	Trials	K (sat) (cm hr^{-1})	T.P. (%)	NCP (%)	A.S. (%)	Yield (t ha^{-1})	
						Grain	Straw
1	Maize straw	11.2	58.3	21.1	39.5	1.29	5.79
2	Pig manure	8.9	56.0	20.0	48.6	.63	6.46
3	Municipal compost	8.6	56.4	20.1	54.3	2.50	6.58
4	Sugarcane bagasse	10.5	57.0	20.3	42.4	1.25	5.92
5	Groundnut husk	6.0	57.9	21.3	49.8	1.42	5.75
6	Control	5.5	56.8	20.4	33.2	1.21	5.63
	CD (P=0.05)	0.9	NS	NS	NS	0.13	0.73

TP = Total porosity NCP = Non-capillary porosity
A.S. = Aggregate stability K (sat) = Saturated hydraulic conductivity

The non-capillary porosity of the post-harvest soil sample of the first crop with finger millet increased significantly in T_3 (Municipal compost) and the rest were on a par with the control plots. Municipal garbage compost with a high organic matter content should improve soil physical properties according to Galladolara and Nogales (1987).

Aggregate stability in the second experiment was not significant but in the first experiment with ragi, it significantly increased in T_2, T_3 and T_4, the others being on par with control plots. Municipal compost established its significant stable aggregate formation than the rest of the organic waste materials. Allison (1968) reported that incorporation of bio-residues improved formation and stabilization of soil aggregates.

Summarising, it was seen that biological wastes when applied to red sandy loam soils improved the important physical parameters and resulted in higher yields of finger millet (Co 10). But significantly higher yields of finger millet grain and straw were obtained (Table 1) in pig manure and municipal compost incorporated plots over control plots. In the second experiment with maize, of the physical parameters tested, hydraulic conductivity (saturated) and aggregate stability alone have been significantly influenced by the organic wastes though other parameters did not show significant changes. Final grain yield of maize obtained from the treated plots were higher than the control plots and the yield from municipal compost plots were the highest and significantly superior than the rest followed by pig manure and groundnut husk mixed plots. The straw yield of maize form the pig manure and municipal compost treated plots were on par and significantly superior to the rest of the plots which were on par.

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Balance sheet of nutrients in direct seeded rice as influenced by irrigation regimes

R. BALASUBRAMANIAN AND J. KRISHNARAJAN

Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore - 641 003, Tamil Nadu

Abstract : The influence of irrigation regimes on uptake and balance sheet of nutrients was studied by conducting field experiments during kharif and rabi seasons of 1997. The highest levels of soil available nitrogen, phosphorus and potassium as per balance sheet was recorded with irrigating 2.5 cm depth three days after disappearance of ponded water due to lower crop uptake. But the highest actual soil available nutrients was recorded with irrigating 5 cm depth one day after disappearance of ponded water except soil available potassium. The highest soil available potassium was recorded with irrigating 2.5 cm depth three days after disappearance of ponded water. The highest grain yield was recorded in plots received with irrigation to 5 cm depth one day after disappearance of ponded water. Similarly, the same irrigation regime recorded the highest net returns and benefit cost ratio. (*Key Words* : *Water, Balance Sheet, Direct Seeded Rice).*

Efficient use of nutrients is essential for better crop management. Water is one of the critical inputs and the largest single cost in crop production. Praveen Rao *et al.* (1993) reported that water is the primary factor influencing the efficient use of applied fertilizer nutrients, since it is directly involved in