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Effect of Organic Residues on Physical Properties of Soil and Yield of Sorghum (CSH 5)

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Incorporation of organic residues, farm yard manure or pig manure at 25 t/ha and removal of hard pans having high bulk density occurring at shallow depths in red soils of Pichanur series, Coimbatore district, increased the yield of sorghum (CSH 5), reduced the bulk density of soil and improved the physical properties like hydraulic conductivity, infiltration rate, porosity, stability index and aggregate stability. The organic carbon content of the soil was improved by the addition of the organic residues.

Hard pans are known to affect plant growth by restricting root penetration, leading to reduced moisture and nutrient uptake from the soil. The movement of air, water and nutrients in the soils is also affected by presence of hard pans. Sharma and Verma (1971) reported progressive decrease in height of plant, tillering, root growth and yield of wheat with increase in bulk density from 1.3 to 1.55 g/cc.

Profile studies conducted in Coimbatore district revealed the presence of hard pans occurring at shallow depths In Pichanur series which was found to affect crop growth, resulting in reduced yield. With a view to study the improvement of the physical conditions of these soils for increasing crop growth and yield, a field experiment was conducted in the problem area in a farmer's holdings.

MATERIAL AND METHODS

A profile was examined at Kandegounden Chavadi village in the soil of Pichanur series, Coimbatore district Occurrence of hard pan was observed at a depth of 19 - 56 cm (Table I). A field experiment was conducted in which the hard pan was broken using a chisel plough and the field was deep ploughed with a tractor. Organic residues like farm yard manure and pig manure were incorporated at 15 to 20 cm depth. Randomised block design with three treatments and seven replications was adopted for the field experiment. The treatments were chiselling with application of farm yard manure at 25 t/ha (T_1), chiselling with application of pig manure at 25 t/ha (T_2) and control (chiselling alone) (T_3). The size of each plot was 6 × 8 m and the test crop was sorghum (CSH 5). An uniform dose of 100 kg N, 60 kg P_2O_5 and 40 kg K_2O /ha was applied to the crop. Half the N was applied as basal dressing and the other half on the 30th day after sowing. All P_2O_5 and K_2O were applied as basal dressing. The nutrient contenf of amendments was not considered while applying fertilizers since

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TABLE I Profile Description — Pichanur series (Coimbatore District)

Horizon	Depth	Description
Ap	0—19 cm	Dark reddish brown (5 YR 3/4) moist, reddish brown (5 YR 5/4) dry, loam-sand; weak, medium, granular, non-sticky and non-plastic, moist, very friable, dry, loose; effervescence nil, few fine to medium roots, rapid permeability, clear smooth boundary.
B2	19—56 cm	Dark reddish brown (2.5 YR 3/4) moist, clay loam, moderate medium sub-angular blocky, sticky and slightly plastic, moist, friable, dry hard, no effervescence, few very fine roots; many gneissic gravels (less than 1 cm), clear smooth boundary.

the availability of these nutrients during the short growth period of sorghum test crop is likely to be small. The grain and straw yields were recorded and post-harvest core soil samples were collected at 20 cm depth.

The analysis of soil samples for physical properties was done in triplicate and mean values are reported. The bulk density was estimated as the ratio between the weight of soil to its volume under field condition (Dakshina murthi and Gupta, 1968). Hydraulic conductivity was estimated using constant head permeameter and calculated as per Darcy's equation. Yoder's wet sieving technique (Yoder, 1936) was adopted for aggregate analysis and the aggregate stability and stability index were calculated. Porosity was estimated by Buchner funnel method (Dakshinamurthi and Gupta, 1968). Infiltration rate was estimated by using double ring infiltrometer. The organic carbon content of the soil was estimated as per the method of Walkley and Black (1934).

TABLE I (Contd.) Physical Properties of Profile in Pichanur series

Physical properties	0—19cm	19—56 cm
Bulk density g/cc	1.64	1.76
Hydraulic conductivity cm/hr	4.09	3.80
Total porosity %	51.58	40.45
Capillary porosity %	27.15	29.13
Non-capillary porosity %	24.43	11.32
Stability index	17.70	16.80
Aggregate stability %	44.0	34.0
Infiltration rate cm/hr	3.10	2.65
Clay %	23.10	27.40
Silt %	9.30	12.2
F. sand %	32.60	23.3
C. sand %	33.60	36.8

RESULTS AND DISCUSSION

The yield of grain and straw of CSH 5 sorghum are furnished in Table II. Application of pig manure and farm yard manure increased the grain and straw yield significantly over control. Pig manure was superior to farm yard manure in improving

TABLE II Grain and Straw Yield of Sorghum (CSH 5) and Organic Carbon Content of Post-Harvest Soil Samples.

Treatment	Grain yield (kg/ha)	Straw yield (kg/ha)	Organic carbon %
T_1	4220	18030	0.495
T_2	5390	19700	0.756
T_3	3000	15800	0.294
S. E.	170	300	0.023
C. D. at 5%	530	900	0.071

TABLE III Physical Properties of Post-Harvest Soil Samples (20 cm depth)

Treatments	Bulk density g/c. c.	Hydraulic conductivity cm/hr	Stability index	Aggregate stability %
T_1	1.68	6.39	29.44	54.4
T_2	1.69	8.19	26.20	50.6
T_3	1.72	4.35	21.74	43.3
S. E.	0.0053	0.42	1.06	2.20
C. D. at 5%	0.016	1.28	3.26	6.77

the yield. The organic carbon content of the soil in pig manure treated plot was higher than in the other two treatments.

The physical properties of initial soil showed that the bulk density of soil increased with depth from 1.64 to 1.76 g/cc (Table I). The total and non-capillary porosities, hydraulic conductivity and infiltration rate showed decrease with depth, evidently indicating the adverse influence of hard pan on the above soil properties. The clay content showed increase with depth.

The physical properties of post-harvest soils indicated that the bulk density of soils was reduced from 1.76

TABLE III Contd.

Treatments	Total porosity %	Capillary porosity %	Non-capillary porosity %	Infiltration rate cm/hr (Mean of 3 replications)
T_1	49.9	28.5	21.4	4.61
T_2	50.1	29.5	20.6	5.30
T_3	47.9	30.1	17.8	3.35
S. E.	0.25	0.59	0.56	
C. D. at 5%	0.76	1.81	1.74	

T_1 . . Chiselling + FYM at 25 tons/ha

T_2 . . Chiselling + pig manure at 25 tons/ha

T_3 . . Control (Chiselling alone)

to 1.72 g/cc by using chisel plough alone, while chiselling with the application of organic residues like pig manure and farm yard manure decreased the bulk density of soil from 1.76 to 1.69 and 1.68 g/cc respectively (Table III) Morachan *et al.* (1972) reported decrease in bulk density of soil by application of organic residues. Hydraulic conductivity was significantly improved in pig manure and farm yard manure treatments compared to control. The above treatments were on par and superior to control in improving the physical properties like stability index, aggregate stability and non-capillary porosity. The infiltration rate showed an increase of 40 to 50 per cent over control in organic residues treatments. Ravi Kumar *et al.* (1975) observed that application of organic amendments like poultry, turkey and pig manure at 10 t/ha improved the hydraulic conductivity aggregate stability and stability index of red sandy loam soils and the present findings are in agreement with the above.

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