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EFFECT OF CHISELING AND AMENDMENTS ON THE MANAGEMENT OF SOILS HAVING IMPERVIOUS LAYER AT SHALLOW DEPTHS

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Occurence of hard pans at different depths of the cultivated soils is one of the serious soil physical problems encountered which are known to affect the crop growth and yield due to the restricted movement of air, water and nutrients and root penetration. Any attempt to break this barrier is bound to have notable benefits. The aim of this study was to investigate the effect of chiseling and the addition of organic amendments on the yield of sorghum grown in a soil having impervious layer at shallow depth. The results of the experiment revealed that both chiseling at closer intervals and the addition of amendments like groundnut husk and rice husk had increased the yield of sorghum grain and starw over control. The physical properties of the soil viz., bu k density, stability index and hydraulic conductivity examined at the post harvest stage were also found to be improved considerably due to chiseling and addition of organic amendments.

Although conditions leading to the development of pan in the soil are very many, hard pans developed in arid climates are associated with sufficiently long period of weathering. Besides the age, proportion of mobile silica in soil solution being precipitated as a cement and the proportion of clay synthesised *in situ* to the proportion that has been washed in to it from above are important factors. Hard pans are sub surface horizons at different depths cemented by silica. Oxides of Fe and Al, clay and $CaCo_3$ are the other accessory cementing agents. The hard pans are known to affect the root penetration by restricting the movement of air, water and nutrients and in turn the plant growth.

Bench mark profile studies conducted in Coimbatore district revealed the presence of hard pans occurring at shallow depths and this was found to hamper root growth and ultimately the crop yields. With a view to improve this adverse soil physical condition and to develop suitable technology for maximisation of crop growth, a field experiment was conducted in farmers holding.

MATERIAL AND METHODS

A field experiment was laid out at Kande Kavundan chavadi (Coimbatore, Tamil Nadu) with Co. 23 sorghum as test variety. A plot size of 7x5 m was adoped. The experiment was laid out in split plot design with three replications. and the particulars of the experiment were as follows:

The main plot treatments were chiseling 0.5m apart (T_1), 1.0 metre (T_2),

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1.5 metre apart (T_1) and no chiseling (T_4). The subplots consisted of groundnut husk at 5 tonnes/ha' (A_1), rice husk at 5 tonnes/ha (A_2) and control (A_0).

Recommended doses of fertilizers viz., 100 kg N, 90 kg P_2O_5 40 kg K_2O /ha were applied in the form of urea, super phosphate and muriate of potash, respectively. Half the N and the entire quantities of P and K were applied as basal dose and the other half of N was applied as top dressing on 30th day after sowing. The crop was grown to maturity and the yield of sorghum grain and straw were recorded. Soil samples at post harvest stage were collected as pear the guidelines for the analysis of various physical properties. Bulk density was estimated adopting the procedure of Dakshinamoorthy and Gupta (1968). Hydraulic conductivity was estimated using constant head permeameter and calculated as per Darcy's epuivation, Yoder's wet sieving techniq ie was adopted for aggregate analysis and the stability index was calculated. Infiltration rate was estimated by using double ring infiltrometer.

RESULTS AND DISCUSSION

Important physical properties of the experimental field soil are presented in Table-1 The yield of grain and straw of Co 23 sorghum are given in Table-2. The treatments tried had marked influence on the yield of sorghum grain and straw. The effect of chiseling at closer intervals was spectacular and registered the highest yield of sorghum grain compared to chiseling at wider intervals and no chiseling. The straw yield data also revealed the same trend of results.

Considering the effects of organic amendments when superimposed over different intervals of chiseling on the performence of sorghum grain and straw it could be seen that the addition of amendments was found to be superior to control. However, there existed no difference between the amendments tried. The chiseling at closer interval and the addition of organic amendments creating a better soil physical environment as could be seen from the physical properties of the soil data presented in Table-3 could have accounted for an increased yield of sorghum grain and straw. Reduction in bulk density of the soil leading to an increase in the yield of sorghum grain and straw observed in the present study is in agreement with the findings of Lawry *et al.* (1970), Sharma and Verma (1971) and Rammohan Rao and Kathavate (1972) who found reduced yield of crops due to an increase in the bulk density of soil.

The physical properties of the soil examined at post harvest stage of Co 23 sorghum are presented in Table-3. It was interesting to observe that rhe bulk density of the soil was considerably reduced due to chisedling at different intervals. Closer the chiselling greater was the reduction in the bulk density compared to the original bulk density of the soil. The bulk density of the soil under control (country plough) was nearly the same as the initial bulk density.

The role of any organic amendment in reducing the bulk density of soil is very well known. The addition of groundnut husk and rice husk has significantly reduced the bulk density of the soil as could be expected. This is in confirmation with the observations of Morachan *et al*. (1972), who obtained a decrease in the bulk density of soil due to the application of organic amendments. The interaction between chiseling and addition of organic amendments also revealed that the addition of amendments, irrespective of the chiseling intervals reduced the bulk density. Similarly closer chiseling progressively reduced the bulk density under all amendments tried.

Considering the data relating to stability index (Table 3) it could be inferred that chiseling seems to have certain beneficial effects in improving the aggregation of the soil compared to control. This may be due to addition of root residues in greater amount because of greater root penetration due to chiseling. The effect of amendments on the aggregation was not pronounced. Ravikumar *et.al.*, (1975) observed improvement in the stability index of soil due to the application of organic amendments. The addition of organic amendments like groundnut husk and rice husk produced higher stability index than control, receiving no organic amendment. The nature and the rate of decomposition of the amendment could also influence the stability index of the soil, because of the differences in the product of decomposition of added amendments. Groundnut husk which gets decomposed relatively faster than the rice husk has registered numerically higher stability index value than rice husk.

The interaction between chiseling and organic amendments was significant, indicating the combined influence of the treatments on the stability index. Irrespective of the chiseling intervals, the addition of organic amendments tregistered higher stability index than control. Not withstanding the addition of organic amendment, chiseling at different intervals improved the stability index over control.

The hydraulic conductivity, a measure denoting the permeability of the soil, is one of the most importantly physical parameters relating to the management of soils having impervious layer at shallow depths. It could be seen from the data presented in Table 3 that there was corresponding increase in the hydraulic conductivity of the soil with decrease in intervals at which chiseling was done chiseling at closer intervals have broken the dense layers at closer intervals causing considerable increase in the hydraulic conductivity which could be expected in such problem soils. The addition of organic amendments also had significant influence on the hydraulic conductivity The hydraulic conductivity of the soil receiving groundnut husk was the highest, followed by rice husk and control. The groundnut husk being less denser and with high decomposition rate than rice husk, has provided better environment for greater hydraulic conductivity.

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Table 1 Physical Properties of Pichanur soil series

Horizon depth/Properties	0—19 cm	19—42	42—60cm
Texture	Sandy clay loam	Gravelly clay	Gravelly clay loam
Structure	Sub angular blocks	Prismatic	Massive
Bulk Density (g/cc)	1.55	1.72	1.62
Hydraulic conductivity (cm/hr)	8.50	6.60	9.10
Stability Index	20.3	31.5	46.5
Mean weight Diameter	0.62	1.90	0.98
15 bar moisture	2.0	9.9	9.1
Infiltration rate (cm/hr)	5.0	—	—

Table 2 Grain and straw yield (Kg/35m²) of Co. 23 Sorghum grain in a soil Having in pervious Layer at Shallow Depths.

Treatments	Grain yield				Straw yield			
	A_1	A_2	A_3	Mean	A_1	A_2	A_3	Mean
T_1	17.0	16.0	13.5	15.7	69	84	62	71.3
T_2	15.0	14.5	11.5	13.7	59	43	45	49.0
T_3	10.8	9.3	6.3	8.8	39	42	36	39.3
T_4	4.8	5.0	4.7	4.8	36	33	28	32.3
Mean	12.0	11.3	9.0		50.6	50.6	42.6	
	CD T		2.78				15.3	
	DD A		1.52				7.21	

Table 3 Physical Properties of post Harvest soil Samples (0—20)

	Bulk density (g/cc)				Stability index				Hydraulic conductivity (cm/hr)			
	A_1	A_2	A_3	Mean	A_1	A_2	A_3	Mean	A_1	A_2	A_3	Mean
T_1	1,41	1,39	1,46	1,42	33.5	33,0	29,5	32.0	14,5	12,9	11,8	13,1
T_2	1,42	1,42	1.48	1.44	33.2	34.9	33.0	33,7	11,8	12,3	9.4	11.2
T_3	1,52	1,50	1.52	1,51	36,6	29 6	27.9	31.4	10,3	9.5	9.1	9,6
T_4	1.51	1.59	1,62	1 57	30.0	30,9	25,2	28 7	7.0	5.0	3,8	5.3
Mean	1,46	1,47	1,52		33.3	32,1	28.9		10.9	9,9	8,5	

	Bulk density	Stability index	Hydraulic conductivity
CD T	0 014	0.98	1.02
CD A	0,012	0,98	1.23
CD TXA			
A at T	0.024	1,81	
T at A	0,024	1.77	