Incorporation of Sesbania rostrata green manure at 6.25 t ha^{-1} one week prior to sowing, inoculation of Azolla at 1.0 t ha^{-1} 15 DAS and incorporation of multiplied Azolla 15 days later, in combination with application of prilled urea at 125 kg ha^{-1} in four equal splits at tillering, panicle initiation, heading and flowering can be the best integrated nitrogen management practice for wet seeded rice under West Zone agroclimatic condition of Tamil Nadu.

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(Received : May 1999 Revised : May 2000)

Madras Agric. J., 86(10-12): 532-535 October - December 1999
https://doi.org/10.29321/MAJ.10.A00649

INFLUENCES OF ORGANIC WASTES AND CHISELLING ON THE SOIL PHYSICAL PROPERTIES AND YIELD OF SORGHUM (CO 24) IN ALFISOLS WITH HARD PAN SUB SOIL

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ABSTRACT

In soils with hard pan sub soils chiselling increased the non-capillary porosity at the sub surface (20-40 cm) from 5.6 to 10.0 per cent. At this depth the bulk density decreased from 1.76 Mg m^{-3} to 1.66 MG m^{-3}, the hydraulic conductivity improved from 1.4 to 2.7 cm hr^{-1}. Chiselling resulted in improved grain yield by 35.5% over the control (6.09 q ha^{-1}). Addition of pressmud at 10 t ha^{-1} and coirpith at 5 t ha^{-1} over and above chiselling increased the grain yield by 37.9 and 56.4 per cent over the control respectively.

KEY WORDS : Sub soil hard pan, Chiselling, Physical properties, Sorghum.

The common soils in tropical areas are Alfisols, Ultisols and Oxisols. These soils present argillic horizons indicating that clay particles can move easily within the soil profiles. Such horizons are present in the surface as crusts and in the sub-surface as a hard pan or impervious layer. When such impervious layers are to be found at shallow depths they pose agronomic problems due to the

Table 1. Important physical properties of the experimental site.

Properties	Soil depth (cm)	
	0 - 20 cm	20 - 40 cm
Texture	Sandy clay loam	Gravelly clay
Structure	Subangular blocky	Massive
Bulk density (Mg m^{-3})	1.66	1.82
Hydraulic conductivity (cm hr^{-1})	8.00	4.60
Total porosity (%)	38.30	26.50
Non-capillary porosity (%)	13.90	9.20

inherent physical properties such as high bulk density and penetration resistance; the optimal use of the sub soil by the roots is restricted; consequently there is poor yield. Chisel ploughing such soils was observed to increase the available soil water content and yield of crops (Sidiras *et al.*, 1987; Ramanathan *et al.* 1983). Increased sugarbeet yields were obtained by Ide *et al.* (1987) by ploughing the sub soil with special plough soles. In the present paper the effect of chiselling and application of amendments are discussed for Pichanur soil series with a hard pan sub soil at a very shallow depth.

MATERIALS AND METHODS

A field trial was carried out in well drained soil in Kandakavundan Chavadi in Coimbatore. The soil belongs to the Pichanur series (Typic Haplustalf). The important physical properties are furnished in Table 1. The trial consisted of the following treatments.

Main Plots : Tillage (T)

T1 - Conventional plough (Control)
T2 - Chisel plough

Sub Plots : Amendments (A)

A0 - Control
A1 - Pressmud at 10 t ha^{-1}
A2 - Coirpith at 5 t ha^{-1}

The maximum working depth of the chisel plough was 40 – 50 cm and the distance between two chisel furrows was 1 metre which was achieved by the tractor following the line of the previous passage of the chiseller. By chiselling, the sub soil is loosened without turning the subsoil or bringing into the surface. In the chiselled plots, the chisel plough was worked once in the north-south direction followed by ploughing in the east-west direction, so that the area inside the cross section was broken up creating hairline cracks.

The amendments as noted above were applied in the plough furrows in both the chiselled and control plots (ploughed by country plough). A week after chiselling, the fields were ploughed normally. Recommended doses of N, P_2O_5 and K_2O viz. 50:25:25 kg ha^{-1} in the form of urea, superphosphate and muriate of potash, were applied basally. CO 24 sorghum was sown as the test crop. The trial was laid out in the split-plot design and replicated three times.

Undisturbed soil core samples representing two depths, viz. 0 – 20 and 20 – 40 cm were collected at the presowing and post harvest stages. Separate surface samples were collected and analysed for aggregate parameters. Core samples were nalaysed for bulk density, hydraulic conductivity, total, capillary and non-capillary porosity by the standard methods. At harvest, grain and straw yields were recorded and statistically analysed and the results discussed.

RESULTS AND DISCUSSION

Porosity

The physical properties of the post-harvest soils are furnished in Table 2. Chisel ploughing increased the total porosity from 39.5 to 41.3 per cent at the 0 – 20 cm layer and from 38.2 to 39.9 per cent at the 20 – 40 cm layer. Application of pressmud was found to improve the total porosity only to a lesser degree.

The non-capacity porosity (NCP) of the 20 – 40 cm layer was remarkably increased from 7.6 to 10.0 per cent due to chiselling the increase being 31.6 per cent. Though there was significant increase in NCP due to incorporation of amendments, among the amendments, there was no significant difference. The percentage increase due to pressmud incorporation was 30.9 and due to coirpith incorporation 42.3.

Table 2. Effect of amendments and tillage on physical properties of soil at harvest

	TP (%)		NCP (%)		BD (Mg m^{-3})		HC (cm hr^{-1})		Yield (q ha^{-1})	
	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	Grain	Straw
Tillage (T)										
Conventional plough (T_1)	39.5	38.2	15.1	7.6	1.62	1.76	8.1	5.1	6.09	26.9
Chisel plough (T_2)	41.3	39.9	17.0	10.0	1.50	1.66	13.2	8.2	8.25	30.1
CD (P=0.05)	1.9	1.2	1.5	2.1	0.09	0.08	2.5	1.1	0.92	2.9
Amendments (A)										
No Amendments (A_0)	39.6	37.4	15.3	7.1	1.62	1.73	9.6	4.4	6.09	26.5
Pressmud (APM)	40.7	39.6	16.1	9.3	1.58	1.68	10.8	6.3	7.25	27.7
Coirpith (ACP)	41.0	39.6	16.8	10.1	1.49	1.64	11.5	7.9	8.35	31.4
CD (P=0.05)	NS	0.6	0.5	1.0	0.08	0.04	1.1	0.4	1.05	1.9

TP = Total porosity ; NCP = Non-capillary porosity ; BD = Bulk density ; HC = Hydraulic conductivity

Bulk density

The bulk density in the control plot was 1.66 Mg m^{-3} at the surface and 1.82 Mg m^{-3} in the subsurface. By conventional method it was reduced to 1.62 Mg m^{-3} in the surface and 1.50 Mg m^{-3} in the subsurface layer. Among the amendments tried, pressmud reduced the bulk density by 0.04 and 0.13 Mg m^{-3} at the harvest stage in surface and subsurface layers respectively.

Table 3. Combined effect of tillage and amendments on physical parameters.

Properties	0-20 cm			20-40 cm		
	A_0	APM	ACP	A_0	APM	ACP
Total porosity (TP) (%)						
T_1	38.8	39.9	39.9	36.6	38.9	39.2
T_2	40.4	41.5	42.0	38.2	40.3	41.3
Non-capillary porosity (NCP) (%)						
T_1	14.3	15.2	15.7	6.1	7.7	8.9
T_2	16.2	16.9	17.8	8.0	10.8	11.2
Bulk density (BD) (Mg m^{-3})						
T_1	1.67	1.64	1.55	1.78	1.73	1.68
T_2	1.57	1.51	1.43	1.68	1.63	1.59
Hydraulic conductivity (HC) (cm hr^{-1})						
T_1	7.0	8.3	9.0	2.5	4.4	5.5
T_2	12.2	13.3	14.0	6.3	8.1	0.2

CD (P=0.05)	Depth	TP	NCP	BD	HC
A x T	0 - 20 cm	NS	2.1	0.10	3.2
	20 - 40 cm	NS	3.2	0.09	2.5

Table 4. Interaction effect of amendments (A) and tillage (T) on yield sorghum (Var. CO 24)

	Grain (q ha^{-1})			Straw (q ha^{-1})		
	A_0	APM	ACP	A_0	APM	ACP
	5.76	5.63	6.87	25.2	26.7	28.7
	6.28	8.66	9.82	27.7	28.7	34.0

CD (P=0.05)	Grain	Straw
A x T	3.20	2.46

Hydraulic conductivity

Hydraulic conductivity of the chiselled plots were significantly higher than conventionally ploughed plots, the increase being 63.0 and 60.8 per cent in 0 - 20 and 20 – 40 cm layers respectively. Application of organic amendments significantly increased the hydraulic conductivity by more than 12.5 and 43.2 per cent in the 0 -20 and 20 – 40 cm layers respectively. The influence of coirpith over pressmud was significant at the subsurface rather than in the surface layer.

Yield

The treatmental effect on sorghum grain and straw yield is furnished in Table 3. The grain yield of sorghum was increased by chiselling from 6.09 q ha^{-1} to 8.25 q ha^{-1}, the increase over the control being 35.5 per cent. The straw yield also increased by 11.9 per cent. Application of coirpith increased the yield of grain and straw by 38.7 and 18.5 per cent over control plots but pressmud increased the yield of grain and straw over control by 20.4 and 4.5 per cent respectively. The interaction effect was highly significant. Chiselling with organic amendments improved the soil physical environment and recorded higher yields. Bhagat and Acharya (1988) reported that straw over control by 20.4 and 4.5 per cent respectively. The interaction effect was highly significant. Chiselling with organic amendments improved the soil physical environment and recorded higher yields. Bhagat and Acharya (1988) reported that organic wastes modified hydrothermal regimes, soil structure and nutrient dynamics and increased crop yield.

Summarizing, it is seen that soil with hard pans at shallow depths despite having the potential fertility for production produced lower yields due to poor aeration, lower hydraulic conductivity and restricted root penetration resulting in limited soil volume availability. These physical problems were alleviated by chiselling such soils one metre apart in both directions perpendicular to each other. Organic amendment such as pressmud at 10t ha^{-1} beneficial in improving the physical properties of the broken up soil layers. This technology result in significantly higher yields of sorghum (CO 24).

ACKNOWLEDGEMENT

Facilities offered by the Tamil Nadu Agricultural University and the Indian Council of Agricultural Research are gratefully acknowledged.

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(Received : March 1999 Revised : May 2000)