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COMPACTION TECHNOLOGY FOR FLUFFY PADDY SOIL

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Fluffy paddy-soils occur in many parts of Tamil Nadu. Such soils allow sinking of working animals and labourers. The strength of such soils can be improved by compaction. This technology involved passing of 400 kg stone roller 8 times over the soil at proctor moisture level. By this method, the bulk density of the soil was increased from 1.11 to 1.33 g/cc and increased the paddy yield by 17.8 per cent over control. Once compacted, the effect on the bulk density remained for 3 successive crops. The cost of compaction was only Rs. 250 per hectare while the net profit was Rs.1200 per hectare. Above all, the working animals did not sink and the labourers could work easily in the field.

Vast extent of the paddy growing rea are clayey. Due to continuous ubmergence and intensive cultivation, uch soils lose their structure and ecome fluffy. The situation is aggre-ated by the incorporation of weeds, addy stubbles and other organic naterials. Howard *et al* (1963) reported hat as the soil strength increased, there vas a reduction in penetration of cotton ap root from 70 to 30 percent. Eavis 1972) observed that penetrometer esistance was the greatest in compacted oil than in lose soil. Raghavan *et al* 1976) conducted a series of tests to tudy the soil density changes under ifferent soil conditions. The change in ulk density varied from 0.08 g/cc to .48 g/cc for increasing number of travels f tractor.

Large extent of paddy soils with very low strength which allows sinking of draught animals are come across in Tamil Nadu. Experiments were carried out at the wetlands of Tamil Nadu Agricultural University, Coimbatore with the objective of finding out a technology to alleviate this problem.

MATERIALS AND METHODS :

The wetland soil was highly clayey, the percentage of clay, silt, fine sand and coarse sand being 50.9, 11.3, 17.6 and 14.8 respectively. A preliminary trial with the following eight treatments were conducted in H block to find out the optimum number of passes with 400 kg stone roller for compaction.

1. Puddled cultivation + sand 10% by weight
2. Dry ploughing followed by flooding and transplanting
3. Compacted by 8 passes + as in Tr.2.
4. ,, by 16 passes + as in Tr.2.
5. ,, by 8 passes + puddled and transplanting.
6. ,, by 16 pasess + puddled and transplanted

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7. Uncompacted + puddled & transplanted
8. Uncompacted + Gypsum at 2 t /ha + puddled and transplanted.

Compaction was done at proctor moisture level. Paiyur 1 paddy was the test crop. The strength of the soil was measured in terms of its bulk density. This trial was continued with the following modified treatments in G Block.

1. Uncompacted-puddled
2. Uncompacted-Unpuddled i.e.dry ploughing followed by flooding.
3. Uncompacted-puddled + gypsum at 2 t/ha
4. Compacted-puddled
5. Compacted-puddled plus gypsum at 2 t/ha

Replication	-	Five
Design	-	Randomised Block design
Plot size	-	4.5 × 20 metres
Crop	-	paddy (var. ponmani)

Compaction was done at proctor moisture level by passing 400 kg stone roller 8 times. NPK fertilizers were applied uniformly for all the plots at 100 : 50 : 50 kg/ha of NPK respectively. Appropriate weed control and plant protection measures were carried out. Initial and post harvest soil cores were analysed for bulk density, hydraulic conductivity and porosity parameters.

Residual effect of compaction was studied by raising two more crops of IR.20 paddy in the same plots. The data were subjected to statistical analysis and are discussed below.

RESULTS AND DISCUSSION :

Results of analysis for bulk density of soil core samples before and after compaction of the preliminary trial is presented in Table 1. It was observed that by compaction, the bulk density of the soil was increased. It increased with the increase in the number of passes. By 8 passes of roller the inerease was from 1.11 g/cc to 1.33 g/cc. When the roller was passed 16 times the bulk density increased further to 1.37 g/cc. Raghavan *et al* (1976) reported that the bulk density increased from 0 08 g/cc to 0 48 g/cc by increasing the number of travels by tractor. The bulk density increases with number of passes, the paddy grain yield was the highest at 8 passes with 6.29 t/ha (Tr. No. 5) which reduced to 4.79 t/ha at 16 passes (Tr. No. 6) while it was 5.13 t/ha for control plots (Tr. No. 7) (Table 2.). Kruger (1970) observed that an increase in the level of compaction increased the yield of barley and it exhibited a parabolic relationship. Similar trend was observed in case of straw yield also. The difference were statistically significant.

The next trial was conducted in G Block of wetlands with modified treatments. Initial bulk density of the surface layer ranged from 1.125 g/cc to 1.81 g/cc with a mean of 1.444 g/cc. The sub soil bulk density ranged from 1.145 g/cc to 1.292 g/cc with a mean of

1.237 g/cc. The hydraulic conductivity of the surface layers ranged from 6.62 cm/hr to 11.92 cm/hr with a mean of 9.15 cm/hr. The sub soil hydraulic conductivity ranged from 6.94 to 10.68 cm/hr with a mean of 8.09 cm/hr. The total porosity ranged from 44.6 to 49.3 per cent with a mean value of 47.1 per cent in the surface layer while it ranged from 34.3 to 38.3 per cent with a mean value of 37.8 per cent in the sub soil layer. The physical parameters of the soils core samples collected from three depths (0-20 cm, 20-40 cm and 40-60 cm) soon after compaction are furnished in Table 3. The data showed that the bulk density of the compacted plots increased from 1.144 g/cc to 1.318 g/cc in the surface layer (0-20 cm) In the sub soil layer (20 40 cm), it increased from 1.237 g/cc to 1.368 g/cc. The total porosity reduced from 47.1 per cent to 39.8 per cent in the surface layer (0-20 cm) and from 38.8 per cent to 35.9 per cent in the sub soil (20-40 cm). The hydraulic conductivity of the compacted plots in the surface layer reduced from 9.9 cm/hr to 8.1 cm/hr while the reduction was from 8.5 to 7 6 cm/hr in the 20-40 cm layer. Reduction in the above parameters due to compaction was also observed by Misone (1963), Childyal (1967) and Dickerson (1976). Above all, the draught animals could easily walk inside the flooded field during puddling and preparatory cultivation operations. Labourers could move freely during transplanting and after cultivation operations.

At harvest, grain and straw yield were recorded (Table 4). Grain yield of 4 38 t/ha was obtained from the control plots (Tr. No. 1) while 5.16 t/ha of grain was recorded in the compacted and puddled plot (Tr. No. 4). The difference in yield was statistically significant and the increase in yield was 17.8 per cent over control. Keller, *et al* (1976) reported a positive correlation between winter wheat yield and the bulk density in a compacted soil.

Post harvest core samples were analysed for the bulk density (Table 5). The statistical analyses of the data showed that the effect of compaction was signifcant and it remained so till the harvest of the crop. The bulk density which is the measure of soil strength remained at 1 32 g/cc A similar trend was observed for other parameters also. namely hydraulic conductivity and porosity.

Two more crops of paddy (IR 50) were raised in the same plots without any further treatments with the objective of studying the residual effect of compaction over time. The yield data and the bulk density of the post harvest core samples are furnished in table 5. The bulk density of the compacted plot (0-20 cm) was 1.410 g/cc after the second crop was harvested. It was significantly higher than that of uncompacted plot (1.117 g/cc). After the harvest of the third crop of paddy also the bulk density remained almost at the same level of the 1.334 g/cc. The trend of results were similar to that of the post harvest soil samples of the first crop.

The yield data and the post harvest soil core analytical results indicated the same trend implying that compaction resulted in better physical environmental conditions of the soil for rice growth in soils of fluffy nature. The effect of compaction lasted for three seasons.

The economics worked out for the first crop (Table 6) showed that the additional cost on compaction is only Rs. 250/-per hectare while a net profit of 1216/per hectare was obtained assuming the price of paddy grains at Rs.1.80 per Kg and straw at Rs. 110/- per ton.

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Table. 1. Influence of compaction on Bulk density (g/cc)

Sl. No.	Treatments	Depth of soil		
		0-20 cm	20-40 cm	40-60 cm
1.	Uncompacted	1.11	1.14	1.12
2	Compacted-8 passes	1.33	1 32	1 25
3.	Compacted-16 passes	1.37	1.44	1.25

Table 2. Effect of compaction on yield of paddy paiyur 1 (t/ha)

Sl. No.	Treatments	Yield in t/ha	
		Grain	Straw
1.	Puddled + sand at 10%	5.37	8.88
2.	Dry ploughing, flooding + transplanting.	4.47	11.15
3.	Compacted-8 passes + as in Tr. 2.	6.13	12.32
4.	„ -16 passes + as in Tr. 2.	4.45	9.18
5.	„ -8 passes + puddled	6.29	11.26
6.	„ -16 „ + „	4.79	8.80
7.	Uncompacted + puddled	5.13	9.55
8.	„ + „ + Gypsum at 2 t/ha	6.26	13.15
	CD (p=0.05)	0.23	2.45

Table 3. Physical Parameters After Compaction

Sl. No.	Treatments	B.D. g/cc		Total porosity %		Non-capillary porosity %		Hydraulic conductivity cm/ha	
		0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	30-40 cm
1.	Uncompacted + puddled	1.140	1.206	47.1	38.8	5.0	3.4	9.9	8.6
2.	„ + Unpuddled	1.150	1.200	47.5	38.3	8.0	2.8	9.5	8.4
3.	„ + puddled + gypsum 2 t/ha	1.140	1.230	47.5	38.8	5.8	3 6	9.7	8.3
4.	Compacted + puddled	1.324	1.368	39.9	35.9	4.9	2.9	8.1	7.6
5.	„ + Unpuddled	1.314	1.372	39.8	35.6	4.2	3.1	8.0	7.5
6.	„ + puddled + gypsum at 2tlha	1.316	1.364	39.7	35.5	4.5	3.5	8.2	7.3
	CD (P=0.05)	0.021	0.029	2.0	0.95	1.2	NS	0.5	0.4

Table 4. Paddy Grain and Straw yield (t/ha)

Sl. No.	Treatments	I CROP (Ponmani)		II CROP (IR. 50)		III CROP (IR 50)	
		Grain	Straw	Grain	Straw	Grain	Straw
1.	Uncompacted + puddled	4.38	11.86	3.38	11 08	5.36	12.40
2.	„ + unpuddled	4.30	10 95	3.33	10.85	4.89	10 40
3.	„ + puddled + gypsum at 2 t/ha	4.59	10.84	3.27	11.47	4.74	11.93
4.	Compacted + puddled	5.16	12.30	3.69	11 19	5.99	14.19
5.	„ + unpuddled	4.53	11.58	3.30	9.76	5.16	12.34
6.	„ + puddled + gypsum at 2 t/ha	4.71	10.94	3.24	11.46	5.05	10.65
	CD (p = 0.05)	0.42	NS	0.43	0.85	0.33	2.09

Table 5. Bulk density of post harvest core samples

Tr.	Particulars	After I crop (paddy)		After II crop (paddy)		After III crop (paddy)	
		0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm
1.	Uncompacted + puddled	1.153	1.152	1.117	1.215	1.116	1.211
2.	„ + puddled	1.150	1.157	1.210	1.233	1.200	1.222
3.	„ + puddled + gypsum at 2 t/ha	1.162	1.162	1.150	1.287	1.129	1.253
4.	Compacted + puddled	1.317	1.368	1.410	1.429	1.334	1.445
5.	„ + unpuddled	1.314	1.334	1.326	1.374	1.311	1.364
6.	„ + gypsum + at 2 t/ha	1.330	1.338	1.355	1.356	1.343	1 338
	CD (p = 0.05)	0.076	0 020	0.084	0.065	0 071	0 077

Table 6. Economics of Compaction Technology

Sl. No.	Particulars	Yield t/ha Grain	Straw	Value of produce Rs. p.
1.	Uncompacted puddled (control)	4.38	11.36	9544-00
2.	Compacted puddled	5.16	12.30	11010-00
3.	Increased return on control	-	-	1466-00
4.	Cost of compaction	-	-	250.00
5.	Net Profit	-	-	1216-00

Value of paddy grain : Rs. 1-80 / Kg

Value of paddy straw : Rs. 140 / t.

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