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Physical Characters of Soil and Residual Root Volume of Rice *(Oryza Sativa L.)* as Influenced by Resource Management in Young Alluviam Soil

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ABSTRACT

Field experiments in split-split plot design with three levels each of tillage (main), irrigation (sub) and nitrogen (sub-sub plot) were conducted on loamy sand soil with three replication during kharif 1996 and 1997 under late (16th August) and timely planting (24th July), respectively to evaluate physical properties as well as root volume Among the treatments only tillage could fetch significant variation by reducing bulk density from 1.49 to 1.41, penetration resistance from 3.26 to 2.63 M Pa and mean weight diameter from 8.19 to 6.40 mm with subsequent increase in water stable macro aggregate (71 mm) from 4.91 to 7.32 per cent, infiltration rate from 0.129 to 0.321 cmhr^{-1}and mean value of root volume from 4.53 to 6.52 cc during the years of experimentation.

Key words: Rice, tillage, irrigation, nitrogen, soil physical characteristics

INTRODUCTION

Crop growth is primarily limited by the physical conditions of the soil, rather than nutrient status. Among the physical constraints are low permeability of heavy textured soil, high permeability of sandy soil, formation of soil crust and plough sole that hinders seeding emergence and restricts root penetration, respectively resulting in unsatisfactory growth of the plant (Gautam, 1982). Although tillage alters rhizosphere environment by changing most of the physical properties, however the extent of change differs considerably depending upon antecedent soil properties and climatic conditions, history of cultural management and type of tillage (Belvins *et al.* 1983). Residual root volume

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adds humus and organic matter, which improves physical properties of soils. It has more importance in young alluvium soils of eastern India where outsource organic sources are meager and rice followed by winter cereals like wheat and maize are major cropping system. Resource management practices have effect both on residual root volume and physical characters. Therefore the present experiment was in aforesaid direction.

MATERIALS AND METHODS

Field experiments were conducted at experimental farm of RAU, Bihar, Pusa on young alluvium loamy sand soil having pH 8.8, O.C.- 0.38%, E.C.–0.26 dsm^{-1}, bulk density 1.45 Mgm^{-3}, available N 225.7 $kgha^{-1}$, available P_2O_5 12.1 $kgha^{-1}$ and available K_2O 87.71 $kgha^{-1}$. The experiment was sown under timely (24th July) and late (16th August) planting conditions in split–split plot design with three treatments, having three level each, of tillage (main), irrigation (sub) and nitrogen (sub-sub plot) with three replications. The levels of tillage treatment were local plough twice + planking (T_1), local plough four times + planking (T_2) and MB plough + cultivator twice + planking (T_3). Irrigation scheduling was on the basis of physiological stages, like initial tillering and flowering (I_1), initial tillering, panicle initiation and milk stage (I_2) and initial tillering, maximum tillering, panicle initiation, flowering and milk stage (I_3) and the levels of nitrogen were 0 (N_1), 60 (N_2) and 120 $kgNha^{-1}$ (N_3) variety used was Saket-4, and planting was done in line at the distance of 15 x 15 cm under late and timely conditions. A basal dose of 60 kg P_2O_5 and 40 kg K_2O and 25 kg $ZnSO_4$ per hectare and half of the total dose of nitrogen as per treatment were applied at the last tillage treatment. The remaining half of nitrogen was top dresses into two splits at maximum tillering and panicle initiation stage. Plots were wedded manually when required. After the harvest of rice observations on surface soil (0-15 cm were recorded on bulk density by core sampler method (Biswas et.al. 1961), soil strength by cone penetrometer (Davidson, 1965). Aggregate analysis by Yoder wet sieving & dry sieving (Hill, 1980, Biswas *et al.* 1961) infiltration rate by Double ring infiltrometer (Bertrand, 1965) and root volume by displacement technique (Mishra and Ahmad 1987).

RESULTS AND DISCUSSION

Bulk Density (BD)

It is evident from the table–1(a) that BD tended to decrease due to increasing level of tillage resulted minimum values (1.41 and 1.41 Mgm^{-3}) under T_3 and maximum (1.49 and 1.46 Mgm^{-3}) under T_1, during 1995 and 1996 respectively. The variation was found significant under all the levels of tillage except T_2 in 1996, which was statistically at par with both T_1 & T_3.

Penetration Resistance (PR)

Observation portrayed in table 1(b) revealed that reduction in PR under T_3 was 15 and 17 per cent as compared to T_1 in 1995 and 1996, respectively. Although reduction in PR was significant due to each increasing level of tillage, however, the magnitude was higher from T_1 to T_2 than that from T_2 to T_3 during both the years of experimentation.

Table 1
Effect of tillage on Physical Properties of Surface soil (0 – 15 cm) after Harvest of Rice

Treatment	*Year* 1996 – 97	1997 - 98	*Mean*
(a) Bulk density (Mg m^{-3})			
T_1	1.49	1.46	1.47
T_2	1.45	1.44	1.44
T_3	1.41	1.41	1.41
SEM (±)	0.0022	0.0066	
CD at 5%	0.01	0.03	
(b) Penetration resistance (Mpa)			
T_1	3.26	3.17	3.21
T_2	2.94	2.89	2.91
T_3	2.76	2.63	2.69
SEM (±)	0.0149	0.0074	
CD at 5%	0.06	0.03	
(c) Mean weight diameter (mm)			
T_1	8.19	8.01	8.10
T_2	7.53	7.25	7.39
T_3	6.62	6.40	6.51
SEM (±)	0.038	0.0178	
CD at 5%	0.15	0.07	
(d) Per cent water stable macroaggregates (>1 mm)			
T_1	4.91	5.73	5.32
T_2	5.73	6.89	6.31
T_3	6.55	7.32	6.93
SEM (±)	0.0258	0.0484	
CD at 5%	0.10	0.19	
(e) Infiltration rate (cmhr^{-1})			
T_1	0.129	0.143	0.136
T_2	0.209	0.222	0.215
T_3	0.309	0.321	0.315
SEM (±)	0.0038	0.0054	
CD at 5%	0.015	0.021	
(f) Root volume (cc)			
T_1	4.24	4.82	4.53
T_2	4.98	5.67	5.33
T_3	6.12	6.91	6.52
SEM (±)	0.1634	0.1239	
CD at 5%	0.64	0.49	

Mean Weight Diameter (MWD)

Increasing level of tillage decreased the MWD Table 1 (c) significantly to the extent of 19 and 20 per cent under T_3 over T_1 but the effect was more pronounced between T_2 and T_3 (12.08 and 11.72 per cent) than that between T_1 and T_2 (8.05 and 9.50 per cent) under late and timely transplanting, respectively.

Per cent Water Stable Macro Aggregate (71 mm), WSMA

There was significant increase in WSMA due to increasing level of tillage (Table 1d) and the magnitude of increase from T_1 to T_2 and from T_2 to T_3 were 16.7, 14.3 and 20.2 per cent during 1995 and 1996, respectively.

Infiltration Rate (IR)

A perusal of table (1e) divulged that T_3 had the maximum IR to the extent of 0.309 and 0.321 cmhr-1 and minimum values 0.129and 0.143 cmhr-1 with T_1 during 1st year and 2nd year experimentation respectively. The variations were found significant however magnitude of variation between T_1 and T_2 and between T_2 and T_3 did not follow the similar trend between the years of experimentation.

Root Volume (RV)

Observation recorded on root volume after the harvest of rice (Table 1f) indicated that T3 had the maximum mean value to the extent of 6.52 cc and minimum 4.53 cc with T_1 and the variations were found significant but the extent of increase was more from T_2 to T_3 than from T_2 to T_1 during the years of experimentation. Although deterioration in physical cultivation of soil due to rice cultivation under puddled condition has been reported by several investigators. But in present investigation, tillage practices were performed under moist condition and the experimental field was upland, reduction in soil hardness (BD & PR) and MWD observed more under MB plough due to increased soil volume (Piageon & Soams, 1978, Nimlos et.al. 1990) and destruction of macro aggregate (Camberdela and Elliot, 1993) which provided conducive environment to root growth and development (RV) as well as higher aggregate stability. Therefore, improvement in soil structure was noticed under MB than local plough where lower RV was recorded due to reduce root soil contact resulting in decreased absorption of water and nutrient (Donald et.al. 1987).

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