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Tillage Effects on Yield of Kharif Rice

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ABSTRACT

A field experiment was conducted on medium land in the central farm of O.U.A.T., Bhubaneswar, during two rainy seasons in 1996 and 1997 to study the effect of tillage practices on rice yield (cv-Lalat). Results revealed that grain yield of rice increased significantly by twice puddling with bullock drawn puddler in both the years. The increase in rice yield was related to the puddling index and its nitrogen uptake.

Introduction

In Orissa, rice is the major crop grown during *kharif* under medium or low land condition. Pudding is one of the tillage practices in rice cultivation. Generally, puddling destroys soil structure and creates a subsurface barrier by reorientation of soil particles, which reduces percolation (Sawhney and Sehgal, 1989) and helps in increasing the yield. Present investigation was carried out to study the effect of different tillage practices on yield of *kharif* rice.

Materials and Methods

Field experiments were carried out in the central farm of Orissa University of Agriculture and Technology, Bhubaneswar in two rainy seasons of 1996 and 1997 to study the effect of different tillage practices on the yield of kharif rice (cv. Lalat). The soil of the experimental site was sandy clay loam with 62% sand, 16% silt and 22% clay, low to medium in organic carbon (OC-0.53%), non saline but alkaline in reaction (pH 8.53) having a CEC of 9.37 cmol (P^+) kg^{-1} and bulk density of 1.77 Mg m^{-3}. The soil has been classifed as a member of fine loamy, mixed, hyperthermic family of Haplaquept.

The experimental plan was randomised block design with the following treatments in the year 1996.

T_1 - One ploughing by tractor at onset of monsoon, twice puddling by country plough.

T_2 - One ploughing by tractor at onset of monsoon, once ploughing by bullock drawn disc plough, once puddling by bullock drawn puddler.

T_3 - One ploughing by tractor at onset of monsoon, once ploughing by bullock drawn disc plough, twice puddling by bullock drawn puddler.

T_4 - One ploughing by tractor at onset of monsoon, *insitu* green manuring with Dhanicha followed by one puddling by bullock drawn puddler.

T_5 - One ploughing by tractor at onset of monsoon, addition of groundnut shell @5 t/ha followed by one puddling by bullock drawn puddler.

In the year 1997, a slight modification was made in the tratment plan. In the case T_5, FYM@5 t/ha was incorporated instead of groundnut shell. Bullock drawn disc plough was replaced by bullock-drawn M.B. plough. One summer ploughing was carried out with bullock drawn MB plough instead of tractor ploughing.

Each treated plot was levelled with wooden plank after puddling to transplant rice. The treatments were replicated thrice in each year.

Rice was grown with a common fertiliser dose of 80-40-40 kg/ha of N, P_2O_5 and K_2O as Urea, Single Super Phosphate and Muriate of Potash, respectively. For the treatments, T_4 and T_5, the nitrogen contributed by the organic sources was adjusted while applying fertilizer. All the phosphorus and potassium fertilizers were applied as basal and nitrogen was applied in three splits (25:50:25) at transplanting, tillering and panicle initiation stages. Soon after puddling, soil water suspension was collected with the help of an aluminium pipe from each plot up to a depth of its insertation and the soil particles were allowed to settle for 48 hours. The puddling index was calculated from the ratio of the volume of soil particles to the total volume of suspension. After the harvest of crop, grain and straw yields were recorded from each plot. Representative plant samples were collected from the plot and analysed for total N (AOAC 1970). Immediately after the harvest of the crop, undisturbed core samples of

5.4 cm diameter and 5 cm long were collected for the determination of bulk density.

Results and Discussion

Puddling index

Table 1 presents the values of puddling index of soil for the two seasons. The puddling indices varied from 60% to 72% during *kharif*, 1996 and 68% to 73% during *kharif* 1997. In both the years, the puddling index was found to be high (72% and 73%) when the soil was puddled twice with the bullock-drawn zigzag puddler (T_3). In the first year, the values of puddling index was minimum in case of puddling twice by country plough (T_1) or once puddling by bullock-drawn puddler (T_2). This value slightly increased in presence of organic matter (Green manuring, T_4 or groundnut shell, T_5). This shows that addition of freshly decomposed organic matter induced dispersibility of soil as indicated by puddling index values. In the second year, 1997, there was a slight increase in the values of puddling index in the respective treatments when the soil was subjected to different intensities of puddling once again. Unlike previous year, puddling index was more due to puddling by country plough (T_1) or puddling once by puddler (T_2). Addition of FYM was found to influence the index to a great extent than the green manuring although these values were lower than that determined in case of puddling twice by puddler (T_3). This shows that addition of organic matter was less effective than intensity of puddling by bullock-drawn zigzag puddler for increasing the puddling index.

Bulk Density

At the beginning the bulk density value was 1.6 Mg m^{-3} in the surface layer (0-15 cm). But it varied from 1.75 to 1.90 Mg m^{-3} in sub surface layer (15-30 cm) (Table 1). The subsurface layer had higher bulk density values due to repeated puddling of the soil. It is to be noted that the bulk density values of surface layer determined at 31 and 62 DAT and at harvest remained more or less same. This shows that various tillage practices done by puddling has no effect in substantially changing the bulk density values. However, it needs to be further investigated.

Grain and Straw Yield

The grain and straw yields of *kharif* rice (Cv-Lalat) for the year 1996 and 1997 are presented in Table 2. Grain yield of rice varied from 38.43 qha^{-1} to 43.73 qha^{-1} in *kharif*, 1996 and from 20.37 qha^{-1} to 25.84 qha^{-1} in *kharif*, 1997. In both the years, the increase in grain yield was found to be maximum and significant due to twice puddling by bullock drawn zigzag (T_3) showing high value of puddling index (Table 1). Although the correlation between the grain yield and puddling index is very poor in the present case, dispersion of clay by puddling appeared to somewhat affect the grain yield of rice. The straw yields (Table 2) exhibited almost similar trend with that of the grain yields. The mean straw yields varied from 39.02 to 46.86 qha^{-1} and from 28.02 to 33.01 qha^{-1} during *kharif*, 1996 and 1997, respectively. The straw yield was maximum and significant when soil was puddled twice by bullock-drawn zigzag puddler (T_3). Thus increasing the intensity of puddling from once to twice has resulted in a significant increase in dry matter production of rice in this soil.

The response of rice to puddling was effective even if the clay content in soil was about 22 to 34%. Grant (1965) indicated that soils responded to puddling when the clay content in soil varied from 25 to 50%. Although the organic matter

Table 1. Puddling indices and bulk density of soil during rice growth as affected by different tillage practices

Treatments	Puddling Index (%)		Bulk density, Mg m^{-3}					
			Before rice transplanting		31DAT	62 DAT	After rice harvest	
	1996	1997	0-15 cm	15-30 cm	0-15 cm	0-15 cm	0-15 cm	15-30 cm
T_1	60.00	70.00	1.65	1.81	1.69	1.66	1.61	1.86
T_2	62.00	70.00	1.67	1.90	1.65	1.66	1.65	1.81
T_3	72.00	73.00	1.65	1.79	1.60	1.54	1.66	1.88
T_4	67.00	68.00	1.62	1.75	1.67	1.69	1.69	1.76
T_5	64.00	69.00	1.64	1.80	1.62	1.59	1.56	1.92

Table 2. Grain and straw yields and nitrogen uptake by rice as affected by different tillage practices

Treatments	Grain (q/ha)		Straw (q/ha)		Nitrogen uptake (kg/ha)	
	1996	1997	1996	1997	1996	1997
T_1	39.22	20.37	42.16	28.28	65.84	32.00
T_2	38.43	22.64	39.02	30.70	64.88	34.88
T_3	43.73	25.84	46.86	33.01	80.90	36.89
T_4	40.59	21.32	43.53	28.02	73.86	25.50
T_5	39.21	22.82	41.57	29.05	73.91	26.96
CD (5%)	2.42	2.24	4.39	3.23	2.40	3.63
CV	3.19	5.26	5.47	5.76	5.44	6.16

increased temporarily, the dispersitivity of soil particles, the use of green manure, groundnut shell or FYM appeared to be less effective in increasing the grain and the straw yields of *kharif* rice at the present level.

Nitrogen Uptake

Data on nitrogen uptake by grain and straw under different treatments (Table 2) showed that total nitrogen uptake during 1996 varied from 64.88 to 80.90 kg ha^{-1}. In 1997 *kharif*, the nitrogen uptake varid from 25.5 to 36.89 kg ha^{-1} due to low yield of grain and straw. But in both the years, the nitrogen uptake was found maximum and significant when the soil was puddled twice by bullock-drawn zigzag puddler (T_3), possibly due to increased availability of soil nitrogen.

From the above result it can be concluded that increasing the intensity of puddling from once to twice in a sandy clay loam soil has resulted in a significant increase in nitrogen uptake, grain and straw yields of rice.

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