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Studies on rice (*Oryza sativa*) productivity as influenced by organic manures and nitrogen levels under different tillage methods

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Abstract

A field experiment was conducted during *kharif* of 2004 and 2005 to study the effect of organic manures and nitrogen levels under different tillage methods in rice. The experiment was laid out in split- plot design with two tillage methods (conventional and reduced) and three organic manure treatments (control, *Sesbania* green manure (*in-situ*) and FYM @ 10 t ha^{-1}) as main plot treatments and four nitrogen levels (0, 30, 60 and 90 kg N ha^{-1}) as sub plot treatments. Total number of tillers, dry matter accumulation and straw yield was higher in conventional tillage during first year. Grain yield was not influenced significantly due to tillage treatments in organic manured plots. Amongst organic manure treatments, *Sesbania* green manuring (*in-situ*) produced significantly highest number of tillers, dry matter accumulation and grain as well as straw yields. Nitrogen application @ 60 kg N ha^{-1} produced significantly more plant height, number of tillers, dry matter accumulation and grain yield as well as straw yield over control. The differences between 60 and 90 kg N ha^{-1} were not significant.

Key words: Tillage, organic manuring, rice, nitrogen levels.

Introduction

Rice is the main cereal food crop in India. Puddling is the most common method of land preparation for low land rice cultivation as it plugs the pores of the soil and increases the water holding capacity. Generally, farmers have a tendency to create a very fine puddle that may not be required. Recently Kirchhof and So (1996) reported that puddling could be reduced without affecting the rice yields, except on sandy soils. In order to reduce the number of puddlings, some other soil amendment is required so as to maintain the water availability to rice crop. Organic amendments are known to improve the soil productivity by improving moisture retention and fertility status of the soils. Incorporation of organics also reduces the requirement of inorganic nitrogen fertilizers. Keeping these points in view, the present investigation was undertaken.

Material and Methods

A field experiment was conducted at CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur during the *kharif* 2004 and 2005. The soil of the experimental site was silty clay loam in texture, having 0.80 per cent organic carbon, 299 kg ha^{-1} available nitrogen, 18 kg ha^{-1} available phosphorus and 211 kg ha^{-1} available potassium with pH 5.8. The experiment was laid out in split plot design with two tillage methods, viz., conventional tillage (Ploughing 15-18 cm deep and 4 runs with wooden puddler followed by planking) and reduced tillage (shallow ploughing 5-7 cm and two runs with wooden puddler followed by planking) and three organic manure treatments, *viz.*, control, *Sesbania* green manure (in-situ) and FYM @ 10 t ha^{-1} as main plot treatments and four nitrogen levels *viz.*, 0, 30, 60 and 90 kg ha^{-1} as sub plot treatments. *Sesbania* green manure (in-situ) was grown for 55 days in the same plots and incorporated one day before the transplanting of rice crop. The field for transplanting was prepared by incorporating *Sesbania* green manure and FYM with conventional and reduced tillage methods in respective treatments. The quantity of nitrogen added through *Sesbania* and FYM was 83.8 and 56.0 kg ha^{-1} during 2004 and 78.5 and 59.0 kg ha^{-1} during 2005, respectively. Half the quantity of inorganic nitrogen fertilizer as per treatment and full dose of 60 kg P_2O_5 and 40 kg K_2O ha^{-1} was applied in each plot as basal dose. Remaining half dose of nitrogen was top dressed in two equal splits each at about 3 and 5 weeks after transplanting of rice. Rice seedlings 2-3 in number (cv HPR-957) were transplanted at a spacing of 15cm X 20 cm.

Results and Discussion

Plant characters

Reduced tillage produced significantly taller plants as compared to conventional tillage during both the years (Table 1). Number of tillers and dry matter accumulation were significantly higher in conventional tillage.

Plant height, tiller numbers and dry matter accumulation increased significantly with the incorporation of organic manures. *Sesbania* green manure treatment produced highest number of tillers and dry matter followed by application of FYM and control treatment with significant differences among themselves.

Table 1. Effect of different treatments on growth characters of rice at harvest

Treatments	Plant height (cm)		Number of tillers m^{-2}		Dry matter accumulation ($g\ m^{-2}$)	
	2004	2005	2004	2005	2004	2005
Tillage Method						
Conventional	66.3	67.7	329	299	973.0	838.2
Reduced	69.7	64.9	308	292	921.8	830.4
CD (P=0.05)	2.34	1.61	11.9	NS	31.14	NS
Organic manure						
Control	64.0	65.0	284	238	737.7	672.9
Sesbania	70.1	67.6	347	344	1092.3	951.1
FYM	69.8	66.3	325	304	1012.2	878.8
CD (P=0.05)	2.86	1.97	14.6	10.7	38.15	36.28
Nitrogen Level (kg ha^{-1})						
0	64.0	63.4	284	216	650.9	556.8
30	67.1	65.9	317	300	973.9	860.7
60	70.2	67.7	337	327	1072.7	948.5
90	70.6	68.3	336	340	1092.0	971.1
CD (P=0.05)	5.52	1.39	16.2	13.2	52.81	42.90

This may be due to higher amount of nitrogen added through *Sesbania* green manure than FYM application. All the growth characters increased significantly with the increase in nitrogen level up to 60 kg N ha^{-1} and further increase in nitrogen level up to 90 kg N ha^{-1} did not influence the growth parameters significantly. The significant effect of increased nitrogen supply may be possible due to the fact that nitrogen being an integral part of proteins, enzymes, chlorophyll and DNA could have helped in cell division and cell elongation there by improving the growth character of the rice crop. Similar findings were also reported by Miah *et al.* (1997).

Grain and straw yield

Higher number of panicles was registered with conventional tillage whereas, spikelets per panicle were higher in reduced tillage method (Table 2). Effect of tillage methods was not significant on rice grain yield whereas straw yield was higher in conventional tillage over reduced tillage method. Incorporation of organic manures significantly increased all the yield attributes, grain as well as straw yield over control. Highest rice yields were produced by *Sesbania* green manuring followed by FYM application while lowest yields were recorded in control plots. The magnitude of increase in grain yield with the application of *Sesbania* and FYM over control treatment was to the tune of 47.3 and 33.5 per cent during 2004 and 47.0 and 32.5 per cent during 2005, respectively. Similar findings have also been reported by Singh (2006). Amongst yield attributes, number of panicles increased significantly with increasing nitrogen levels up to 60 kg N ha^{-1} and number of spikelets per panicle increased significantly up to 30 kg N ha^{-1}. Application of nitrogen @ 60 kg N ha^{-1} increased the grain yield over control by 46.2 per cent and 58.8 per cent, respectively during 2004, however, during the year 2005, increase in grain yield was 49.6 per cent and 60.4 per cent, respectively. The increase in grain yield due to different treatments may be attributed to increase in total number of tillers, dry matter accumulation, effective tillers, number and weight of filled grains. These findings are in close conformity with those of Meena *et al.* (2003)

Table 2. Effect of different treatments on yield attributes and yield of rice at harvest

Treatments	Number of Panicles m^{-2}		Spikelets per panicle		Fertility (%)		1000 grain weight (g)		Grain Yield (q ha^{-1})		Straw yield (q ha^{-1})		Harvest index	
	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005	2004	2005
Tillage Method														
Conventional	270.8	258.8	70.1	72.9	83.6	82.7	23.08	23.41	33.21	31.10	64.09	52.71	0.34	0.37
Reduced	260.6	254.4	74.8	72.5	83.6	82.0	23.12	23.37	32.45	30.48	59.73	52.56	0.36	0.37
CD (P=0.05)	9.71	NS	2.59	NS	NS	NS	NS	NS	NS	NS	3.55	NS	NS	NS
Organic manure														
Control	236.7	214.0	68.2	70.1	80.7	79.8	22.54	22.04	25.87	24.36	47.90	42.92	0.36	0.37
Sesbania	286.6	292.5	77.1	73.7	85.2	83.8	23.47	24.04	38.10	35.81	71.14	59.30	0.35	0.38
FYM	273.7	263.3	72.3	74.3	85.0	83.4	23.28	24.10	34.53	32.21	66.70	55.67	0.34	0.37
CD (P=0.05)	11.90	12.68	3.17	3.07	3.02	3.42	0.58	0.49	1.28	2.07	4.35	3.28	NS	NS
Nitrogen Level (kg ha^{-1})														
0	242.6	196.4	59.2	69.2	82.5	81.6	22.84	22.79	23.39	21.61	41.71	34.07	0.36	0.39
30	266.2	257.8	73.8	75.0	83.9	82.5	23.24	23.48	34.19	32.33	63.20	53.74	0.35	0.38
60	280.7	283.3	77.3	74.2	84.3	82.7	23.14	23.64	37.04	34.67	70.23	60.18	0.35	0.37
90	273.3	288.80	79.9	72.4	83.8	82.6	23.17	23.66	36.71	34.56	72.50	62.55	0.34	0.36
CD (P=0.05)	11.73	10.12	4.95	3.57	NS	NS	NS	0.45	1.90	1.78	4.62	3.11	NS	0.012

Interaction

The interaction between tillage methods and organic manures on rice grain yield was found significant during both the years (Table 3). Under both the tillage methods, rice grain yield increased significantly with the incorporation of organic manures over control. *Sesbania* green manuring recorded significantly highest grain yield followed by FYM incorporation while the lowest yield was recorded in control plots in both the tillage methods. On the other hand, tillage methods did not influence the rice grain yield significantly in *Sesbania* green manure as well as FYM treated plots. Whereas, significant reduction in grain yield was observed in control plots due to reduced tillage. During both the years, significantly higher grain yield was obtained in reduced tillage plots supplied with *Sesbania* green manure while lowest yield was recorded in reduced tillage method with no manure addition.

Table 3. Effect of interaction between tillage methods and organic manures on grain yield (q ha^{-1}) of rice

Treatments	Organic manure					
	2004			2005		
	Control	*Sesbania*	FYM	Control	*Sesbania*	FYM
Tillage Method						
Conventional	28.13	37.20	34.30	27.4	34.6	31.3
Reduced	23.61	38.99	34.75	21.3	37.0	33.1
SEm (±)		0.57			0.93	
CD (P=0.05)		1.80			2.93	

Conclusion

Based on the findings of the present investigation, number of tillage operations can only be reduced in organic manured plots.

Sesbania green manuring was found superior than other organic manuring treatments in increasing rice grain yield. Nitrogen application @ 60 kg ha^{-1} was found effective in rice production.

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