Evaluation of suitable nutrient management over state's recommendation and farmers' practice in rice-rice system of cropping

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In India, the soil test report showed that about 70%of soils are deficient in N, 50% in P and 13% in K. Moreover, disproportionate application of higher doses of N in comparison to P and K is linked to the increasing deficiency of P and K and other secondary and micronutrients. The present ratio of N:P:K at the country lavel is 9:3:1 against standard ratio of 4:2:1 which is the prime cause of lower use efficiency of N,P and K, hardly exceeds 50%, 16-20% and 80% respectively (Singh, 2006). In rice based cropping system the losses of N is very high resulting lower fertilizer use efficiency, enhances cost of production and reduces B : C ratio. Hence, a suitable nutrient management package need to be developed in rice-rice cropping system which ensured sustainable high yield to minimize the gap between the achievable yield by farmers and potential yield through efficient use of nutrients. The present investigation was undertaken in order to formulate suitable nutrient management package over existing farmer's practice and state's recommendation for achieving higher yield and economic return in rice-rice cropping system.

An investigation was carried out during wet and dry season of 2006 – 07 at Central Research Farm, BCKV, Gayeshpur. The experimental soil was sandy clay loam having pH 7.4, total N 168.4 kg/ha, available P 23.8 kg/ha, available K 176.72 kg/ha, available S 37.12 kg/ha and available Zn 1.50 kg/ha. Ten nutrient management treatments along with state's recommendation (Ali, 2006) and farmers' practice were allocated each with four times in a randomized block design. The treatments were as T_1 –0 : 60 : 80 : 20 : 40 – N : P_2O_5 : K_2O : S : $ZnSO_4$ kg/ha to winter rice and 0 : 60 : 80 : – N : P_2O_5 : K_2O kg/ha in summer rice , T_2 – 150 : 60 : 80 : 20 : 40 N : P_2O_5 : K_2O : S : $ZnSO_4$ kg/ha to winter rice and 150 : 60 : 80 kg/ha in summer rice, T_3 – 150 : 0 : 80 : 20 : 40– N : P_2O_5 : K_2O : S : $ZnSO_4$ kg/ha to winter rice and 150 : 0 : 80– N : P_2O_5 : K_2O kg/ha in summer rice, T_4 – 150 : 30 : 80 : 20 : 40– N : P_2O_5 : K_2O : S : $ZnSO_4$ kg/ha to winter rice and 150 : 30 : 80– N : P_2O_5 : K_2O kg/ha in summer rice, T_5 – 150 : 90 : 80 : 20 : 40– N : P_2O_5 : K_2O : S : $ZnSO_4$ kg/ha to winter rice and 150 : 90 : 80– N : P_2O_5 : K_2O kg/ha in summer rice, T_6 – 150 : 60 : 0 : 20 : 40– N : P_2O_5 : K_2O : S : $ZnSO_4$ kg/ha to winter rice and150 : 60 : 0– N : P_2O_5 : K_2O kg/ha in summer rice, T_7 – 150 : 60 : 40 : 20 : 40– N : P_2O_5 : K_2O : S : $ZnSO_4$ kg/ha to winter rice and150 : 60 : 40– N : P_2O_5 : K_2O kg/ha in summer rice, T_8 – 150 : 60 : 120 : 20 : 40– N : P_2O_5 : K_2O : S : $ZnSO_4$ kg/ha to winter rice and150 : 60 : 120– N : P_2O_5 : K_2O kg/ha in summer rice, T_9 – 150 : 60 : 80 : 0 : 40– N : P_2O_5 : K_2O : S : $ZnSO_4$ kg/ha to winter rice and150 : 60 : 80– N : P_2O_5 : K_2O kg/ha in summer rice, T_{10} – 150 : 60 : 80 : 20 : 0– N : P_2O_5 : K_2O : S : $ZnSO_4$ kg/ha to winter rice and150 : 60 : 80– N : P_2O_5 : K_2O kg/ha in summer rice, T_{11} – State's recommendation (150 : 75 : 75 : 10 : 25– N : P_2O_5 : K_2O : S : $ZnSO_4$ kg/ha to winter rice and120 : 60 : 60– N : P_2O_5 : K_2O kg/ha in summer rice, T_{12} – Farmers' practice (100 : 30 : 30 : 0 : 0– N : P_2O_5 : K_2O : S : $ZnSO_4$ kg/ha to winter rice and120 : 40 : 40– N : P_2O_5 : K_2O kg/ha in summer rice) The hybrid variety PHB – 71 and high yielding variety IET 4094 were used during rainy and summer season respectively.

Yield components of winter rice and summer rice system :

The maximum mean number of panicles / m^2 was observed under T_7 (300) followed by T_6 (298), T_2 (295) and states recommendation (T_{11}) with no significant difference among them (Table 1). The positive influence of N and S was observed on increment of mean number of panicle by 8.62% and 5.67% respectively over no use of N (T_1) and S(T_9) in the nutrient package. Similar effect was reported by Munda (1989). Both number of filled grain / panicle and test weight were found to be influenced significantly with the SSNM treatments.

Grain and straw on yield in winter rice and summer rice system

The mean grain yield significantly varied from 4.85 Mg/ha (T_5) to 2.73 Mg/ha (T_1) (Table 1). Highest mean grain yield was obtained from T_5 (4.85 Mg/ha) which was 18.00% and 38.57% more over T_{11} (States' recommendation) and T_{12} (farmers' practice). Like grain yield, straw yield was also varied significantly with different nutrient managements treatments (Table 1).

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Table 1 : Effect of different nutrient managements on yield components, grain and straw yield of winter and summer rice.

Treatment	No. of panicles per sq m			No. of filled grains per panicle			Test weight (g)			Grains yield (t / ha)			Straw yield (t / ha)		
	WR	**WR**	**Mean**	**WR**	**SR**	**Mean**	**WR**	**SR**	**Mean**	**WR**	**SR**	**Mean**	**WR**	**SR**	**Mean**
T_1	190	218	204	87.63	83.83	85.73	23.10	20.88	21.99	2.41	3.05	2.73	3.67	4.33	4.00
T_2	244	346	295	79.86	93.26	86.56	25.01	23.59	24.3	3.19	4.95	4.07	5.36	8.25	6.80
T_3	232	341	286	94.03	103	98.51	24.19	22.78	23.48	3.36	4.44	3.94	5.45	6.54	5.99
T_4	227	327	277	86.20	91.00	88.6	24.64	23.14	23.89	4.26	5.44	4.85	5.46	6.79	6.12
T_5	244	326	285	85.86	100.53	93.19	25.48	21.45	23.46	4.26	5.44	4.85	5.70	7.79	6.74
T_6	238	358	298	78.23	92.50	85.36	24.11	22.94	23.52	3.65	4.61	4.13	5.16	7.11	6.13
T_7	259	342	300	66.83	98.13	82.48	25.14	22.78	23.96	3.75	5.10	4.42	5.68	7.77	6.72
T_8	231	348	289	87.53	107.90	97.71	24.90	24.16	24.53	4.06	5.20	4.63	5.23	8.41	6.82
T_9	243	329	286	99.56	96.06	97.81	25.62	23.27	24.44	3.20	5.05	4.12	5.62	8.33	6.97
T_{10}	213	350	281	59.16	93.93	76.54	23.41	23.74	23.57	2.26	4.58	3.42	5.36	7.74	6.55
T_{11}	229	351	290	82.60	87.13	84.86	24.30	22.54	23.42	3.32	4.91	4.11	5.07	7.72	6.37
T_{12}	220	344	282	81.40	103.46	92.43	24.96	22.65	23.80	2.45	4.55	3.5	7.63	6.69	5.72
SEm(±)	**17.41**	**22.09**	**19.75**	**11.20**	**7.86**	**9.53**	**0.63**	**0.72**	**0.67**	**0.32**	**0.31**	**0.31**	**.36**	**.88**	**.37**
LSD(P=0.05)	**50.95**	**64.67**	**39.97**	**32.78**	**22.58**	**27.89**	**1.83**	**2.08**	**1.95**	**0.78**	**0.76**	**0.77**	**.87**	**2.57**	**0.87**

WR- winter rice, SR- Summer rice

System grain yield in rice – rice system

The system grain yield of rice was found highest under T_5 which was 38.62% and 17.79% higher over farmers' practice (T_{12}) and state recommendation (T_{11}) respectively (Table 2). Similar result was also reported by Sathiya *et al*. (2007). The positive response of N, P, K and Zn on increasing system grain yield of rice was obtained in the order of N (48.99 %) > Zn (20.72%) > P (12.41%) > K (7.12%) as compared to their no use treatment.

Economic analysis

The maximum gross and net return were recorded under T_5 (Rs. 1,18,042 / ha and Rs. 81,868 / ha) due to higher grain and straw yield (Table 2). The net return increased in T_5 over T_{11} (state's recommendation) and T_{12} (farmers' practice) by Rs. 25,477 / ha and Rs. 28,243 / ha respectively. The benefit cost ratio was found highest in T_4 (2.37) followed by T_5. However, the B : C ratio was observed low in both state's recommendation (T_{11}) and Farmers' practice (T_{12}). Similar result was found by Dobermann *et al* (2003).

Changes in soil nutrient status over initial

Available N content in soil after completion of rice – rice system was found higher over initial in T_2, T_5 and T_7 by 16.6 kg/ha whereas other nutrient managements showed negative in available N over initial ranging from (-)5.4 kg/ha (T_8, T_9, T_{12}) to (-) 45.4 kg/ha (T_1) (Table 3). Available phosphorus content in soil over initial was found higher in a range of 1.9 kg/ha (T_8) to 10.9 kg/ha (T_5) while decreasing trend of available phosphorus over initial was noticed in a range from (-) 0.2 kg/ha (T_9) to (-) 9.8 kg/ha (T_3). A positive build up of available K content over initial was observed in all the treatments which ranged from 31.28 kg / ha (T_6) to 132.18 kg / ha (T_8) (Table 3).

Table 2 : Effect of different nutrient managements on economics of rice – rice system of cropping.

Treatments	System grain yield (t / ha)	Cost of cultivation (Rs. / ha)	Gross return (Rs. / ha)	Net return (Rs. / ha)	B:C ratio
T_1	5.46	29,530	66,772	37,242	1.26
T_2	8.14	33,490	1,01,567	68,077	2.03
T_3	7.80	30,116	95,933	65,817	2.18
T_4	8.77	31,802	1,07,429	75,627	2.37
T_5	9.70	35,174	1,18,042	82,868	2.36
T_6	8.26	32,030	1,01,039	69,009	2.15
T_7	8.85	32,760	1,08,795	76,035	2.32
T_8	9.27	34,220	1,13,393	79,173	2.31
T_9	8.25	32,890	1,03,104	70,214	2.13
T_{10}	6.74	32,290	86,468	54,178	1.67
T_{11}	8.23	32,539	1,01,804	69,265	2.12
T_{12}	7.00	30,873	89,122	58,249	1.88

Table 3 : Effect of different nutrient managements on soil nutrient status over initial after one rice – rice system of cropping.

Treatment	Total nitrogen (Kg / ha)	Available phosphorus (Kg / ha)	Available potassium (Kg / ha)
T_1	(-) 45.4	5.6	96.28
T_2	16.6	2.1	117.28
T_3	(-) 14.4	(-) 9.8	91.28
T_4	(-) 14.4	(-) 4.9	83.28
T_5	16.6	10.9	105.28
T_6	(-) 14.4	3.9	31.28
T_7	16.6	3.3	118.28
T_8	(-) 5.4	1.9	132.28
T_9	(-) 5.4	(-) 0.2	105.28
T_{10}	(-) 14.4	5.7	87.28
T_{11}	(-) 14.4	5.1	91.28
T_{12}	(-) 5.4	3.4	118.28

Initial N – 168.4 kg/ha, P_2O_5 – 23.8 kg/ha, K_2O – 176.72 kg/ ha

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