

## Nutrient management in rice-rice crop sequence

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### ABSTRACT

Field experiments were conducted during *boro* seasons of 2004-05 and 2005-06 and *kharif* seasons of 2005 and 2006 at the Regional Research Station, New Alluvial Zone, Bidhan Chandra Krishi Viswavidyalaya, West Bengal to study the comparative effect of manuring under farmer's practice, recommended practice and practice on the basis of soil test. Results revealed that manuring on the basis of soil test produced maximum grain yield ( $10.05 \text{ t ha}^{-1} \text{ year}^{-1}$ ), net return (Rs. 19,996  $\text{ha}^{-1} \text{ year}^{-1}$ ) and return per rupee investment (Rs. 1.51) under rice-rice cropping sequence. This was closely followed by the recommended practice. Soil nutrient status did not change much over initial value due to manuring in different system. On an average total nitrogen content decreased but available P and K content increased slightly.

**Key Words :** Nutrient, rice – rice crop sequence

Rice-rice cropping system is the most important system followed in West Bengal. Farmers apply fertilizer at their own way. For that in some places soil health is disturbing day-by-day. To attain sustainable crop production with minimum deleterious effect of chemical fertilizer, sound recommendation needs to be worked out. With this idea in view present experiment has been planned.

### MATERIALS AND METHODS

The experiments were conducted during *boro* seasons of 2004-05 and 2005-06 and *kharif* seasons of 2005 and 2006 at the Regional Research Sub-Station (RRSS), Chakdaha, Nadia, West Bengal ( $23^{\circ} 5.3' \text{ N}$  latitude and  $85^{\circ} 5.3' \text{ E}$  longitude and at an elevation of 9.75 meter above the mean sea level). Topographically land is called medium land and medium in fertility with good drainage facility. The soil was sandy clay loam in texture (Entisol). The soil had pH 7.5, organic carbon 0.68 %, available P  $16.00 \text{ kg ha}^{-1}$  and K  $126 \text{ kg ha}^{-1}$ . The experiment was

laid out in a randomized block design with 6 treatment combinations (Table 1) in 4 replicates. In all the seasons half of the dose of nitrogen and full dose of  $\text{P}_2\text{O}_5$  and  $\text{K}_2\text{O}$  were given before transplanting and remaining N was top-dressed equally at active tillering and before panicle initiation stage. Rice crop was transplanted on 05.02.05, 17.02.06, 07.08.05 and 08.08.06 and harvested on 12.05.05, 25.05.06, 14.11.05 and 10.11.06 during *boro* seasons of 2004-05 & 2005-06 and *kharif* seasons of 2005 & 2006 respectively.

### RESULTS AND DISCUSSION

#### Effect of manuring in boro season rice

Variety Shatabdi (IET 4786) was grown in *boro* season in both 2004-05 and 2005-06. It took 140 days to mature. The trend of variation of result was very much similar in both the years. For that discussion has been made on the basis of mean of two years. The panicle /  $\text{m}^2$  (480), filled grains / panicle (137.4), 1000 - grain weight (21.26 g), grain

**Table 1 : Different treatment combinations in *boro* and *kharif* season under rice-rice cropping sequence**

Treatments	Applied doses of fertilizer ( $\text{kg ha}^{-1}$ )			
	Boro 2004-05 (N: $\text{P}_2\text{O}_5$ : $\text{K}_2\text{O}$ + $\text{ZnSO}_4$ )	Kharif 2005 (N: $\text{P}_2\text{O}_5$ : $\text{K}_2\text{O}$ + $\text{ZnSO}_4$ )	Boro 2005-06 (N: $\text{P}_2\text{O}_5$ : $\text{K}_2\text{O}$ + $\text{ZnSO}_4$ )	Kharif 2006 (N: $\text{P}_2\text{O}_5$ : $\text{K}_2\text{O}$ + $\text{ZnSO}_4$ )
T <sub>1</sub> – Farmer's Practice	153:54:113 + 0	40:36:44 + 0	153:54:100 + 0	40:36:44 + 0
T <sub>2</sub> – Farmer's Practice + Zn	153:54:113 + 5	40:36:44 + 12	153:54:100 + 10	40:36:44 + 12
T <sub>3</sub> – Recommended Practice	100:50:50	60:30:30	120:60:60	60:30:30
T <sub>4</sub> – Recommended Practice + Zn	100:50:50 + 20	60:30:30 + 12	120:60:60 + 20	60:30:30 + 12
T <sub>5</sub> – Recommendation on the basis of soil test + Zn	120:60:60 + 20	80:40:40 + 20	140:60:60 + 20	80:40:40 + 20
T <sub>6</sub> – Control (No fert.)	-	-	-	-

yield ( $5.73 \text{ t ha}^{-1}$ ) and straw yield ( $5.36 \text{ t ha}^{-1}$ ) were recorded maximum when the crop received nutrients on the basis of soil test (Table 2, 3 & 4). In the farmer's practice treatment, crop received more

amounts of nitrogen (27.5 % more) and potassium (88 % more) and less amount of phosphorus (11 % less) as compared to the nutrient received through recommendation based on soil test. Due to

indiscriminate use of nutrient, yield and other components were low. Performance due to application of recommended doses of fertilizer was in between farmer's practice and soil test result. Rate of application of nutrient in RDF treatment was

slightly lower than the recommendation made through soil test. However, treatment differences were significant. Application of Zn influenced the grain and straw yield and other yield components.

**Table 2 : Panicles / m<sup>2</sup> of rice as affected by manuring during boro 2004-05 and 2005-06 and kharif 2005 and 2006**

Treatments	Boro season			Kharif season		
	2004-05	2005-06	Mean	2005	2006	Mean
T <sub>1</sub> – Farmer's Practice	452	375	414	350	340	345
T <sub>2</sub> – Farmer's Practice + Zn	458	400	425	355	345	350
T <sub>3</sub> – Recommended Practice	462	413	438	385	350	368
T <sub>4</sub> – Recommended Practice + Zn	475	438	457	395	360	378
T <sub>5</sub> – Recommendation on the basis of soil test + Zn	485	475	480	401	380	391
T <sub>6</sub> – Control (No fert.)	330	363	347	300	301	301
Mean	444	411	427	364	346	356
S.Em ±	5.667	5.685	5.676	7.663	7.258	7.460
C.D. (P=0.05)	12.070	12.109	12.089	16.322	15.459	15.889

### Effect of manuring in kharif season rice

The same variety of rice was used in *kharif* season. It took 120 days to mature. The trend of variation of results among treatment in this season was very much similar to that of *boro* season. In this season, in farmer's practice treatment crop received less amount of nitrogen (50 % less) and phosphorus (11 % less) and more amount of potassium (10 % more) than that of recommendation based on soil test. For that the panicles / m<sup>2</sup> (345), filled grain / panicle (101.1), 1000 – grain weight (17.11 g), grain yield (3.10 t ha<sup>-1</sup>) and straw yield (3.88 t ha<sup>-1</sup>) were less than that of soil test (Table 2, 3 & 4) recommendation (391 panicles / m<sup>2</sup>, 125.4 filled grains / panicle, 18.08 g 1000 – grain weight, 4.32 t ha<sup>-1</sup> grain yield and 4.66 t ha<sup>-1</sup> straw yield). Crop when received recommended doses of fertilizer, produced 368 no. of panicles / m<sup>2</sup>, 117.0 no. of filled grains / panicle, 17.32 g 1000 – grain weight, 3.73 t ha<sup>-1</sup> grain yield and 4.17 t ha<sup>-1</sup> straw yield). The result was in between the treatments of farmer's practice and soil test recommendation. Grain yield and all other characters increased slightly due to

application of Zn over no Zn treatments.

### Effect of manuring on system productivity

In the high yielding rice – high yielding rice cropping system in a year it was observed that the highest grain yield (10.05 t ha<sup>-1</sup> year<sup>-1</sup>) was obtained in treatment where rice crop received nutrients on the basis of soil test along with Zn both in *kharif* and *boro* seasons (Table 5). Jana and Ghosh (1996) observed the similar trend of result. In this treatment the crop received 120 kg N, 60 kg P<sub>2</sub>O<sub>5</sub> and 60 kg K<sub>2</sub>O along with 20 kg ZnSO<sub>4</sub> / ha during *boro* season and 80 kg N, 40 kg P<sub>2</sub>O<sub>5</sub> and 40 kg K<sub>2</sub>O along with 20 kg ZnSO<sub>4</sub> / ha during *kharif* season. In farmer's practice treatment, excess amount of fertilizer were applied in *boro* season and on the other hand less amount was given in *kharif* season. This may be the reason for less production in this treatment (8.14 to 8.90 t ha<sup>-1</sup> year<sup>-1</sup>). Grain yield obtained in recommended practice (9.17 to 9.63 t ha<sup>-1</sup> year<sup>-1</sup>) treatment was very near to soil test recommended treatment. Addition of Zn influenced this yield over no Zn treatment.

**Table 3 : Filled grains / panicle of rice as affected by manuring during boro 2004-05 and 2005-06 and kharif 2005 and 2006**

Treatments	Boro season			Kharif season		
	2004-05	2005-06	Mean	2005	2006	Mean
T <sub>1</sub> – Farmer's Practice	113.2	122.9	118.1	101.8	100.1	100.9
T <sub>2</sub> – Farmer's Practice + Zn	120.6	123.9	122.3	113.8	107.5	110.7
T <sub>3</sub> – Recommended Practice	128.8	126.9	127.9	124.3	109.6	117.0
T <sub>4</sub> – Recommended Practice + Zn	137.8	127.0	132.4	125.5	117.7	118.6
T <sub>5</sub> – Recommendation on the basis of soil test+Zn	146.9	127.9	137.4	130.1	120.6	125.4
T <sub>6</sub> – Control (No fert.)	99.0	105.5	102.3	80.1	80.5	80.3
Mean	124.4	122.4	123.4	112.6	105.0	108.7
S.Em ±	3.996	4.001	3.998	2.594	2.356	2.475
C.D. (P=0.05)	8.511	8.522	8.515	5.525	5.018	5.271

**Table 4 : 1000 – grain weight of rice as affected by manuring during *boro* 2004-05 and 2005-06 and *kharif* 2005 and 2006**

Treatments	Boro season			Kharif season		
	2004-05	2005-06	Mean	2005	2006	Mean
T <sub>1</sub> – Farmer’s Practice	20.67	19.29	19.98	17.12	17.10	17.11
T <sub>2</sub> – Farmer’s Practice + Zn	20.96	19.38	20.17	17.19	17.21	17.20
T <sub>3</sub> – Recommended Practice	20.98	19.39	20.14	17.34	17.29	17.32
T <sub>4</sub> – Recommended Practice + Zn	21.57	20.48	21.03	17.99	17.51	17.75
T <sub>5</sub> – Recommendation on the basis of soil test + Zn	21.70	20.81	21.26	18.46	18.50	18.48
T <sub>6</sub> – Control (No fert.)	19.00	18.45	18.73	17.00	17.00	17.00
Mean	20.81	19.63	20.22	17.52	17.44	17.48
S.Em ±	0.075	0.027	0.051	0.049	0.031	0.040
C.D. (P=0.05)	0.159	0.057	0.108	0.104	0.066	0.085

**Table 5 : Grain yield of rice as affected by manuring during *boro* and *kharif* seasons**

Treatments	Boro (2004-05) (t ha <sup>-1</sup> )	Boro (2005-06) (t ha <sup>-1</sup> )	Mean of two years boro (t ha <sup>-1</sup> )	Kharif (2005) (t ha <sup>-1</sup> )	Kharif (2006) (t ha <sup>-1</sup> )	Mean of two years kharif (t ha <sup>-1</sup> )	Total of boro and kharif (t ha <sup>-1</sup> )
T <sub>1</sub> – Farmer’s Practice	5.35	4.73	5.04	3.06	3.15	3.10	8.14
T <sub>2</sub> – Farmer’s Practice + Zn	5.40	5.26	5.33	3.64	3.50	3.51	8.90
T <sub>3</sub> – Recommended Practice	5.45	5.43	5.44	3.86	3.60	3.73	9.17
T <sub>4</sub> – Recommended Practice + Zn	5.64	5.54	5.59	3.93	4.15	4.00	9.63
T <sub>5</sub> – Recommendation on the basis of soil test+Zn	5.90	5.56	5.73	4.15	4.50	4.32	10.05
T <sub>6</sub> – Control (No fert.)	3.93	3.48	3.71	2.60	2.90	2.75	8.26
Mean	5.28	5.00	5.14	3.54	3.63	3.59	8.73
S.Em ±	0.066	0.070	0.068	0.078	0.082	0.080	0.148
C.D. (P=0.05)	0.141	0.149	0.144	0.166	0.175	0.170	0.315

**Table 6 : Straw yield of rice as affected by manuring during *boro* and *kharif* seasons**

Treatments	Boro (2004-05) (t ha <sup>-1</sup> )	Boro (2005-06) (t ha <sup>-1</sup> )	Mean of two years boro (t ha <sup>-1</sup> )	Kharif (2005) (t ha <sup>-1</sup> )	Kharif (2006) (t ha <sup>-1</sup> )	Mean of two years kharif (t ha <sup>-1</sup> )	Total of boro and kharif (t ha <sup>-1</sup> )
T <sub>1</sub> – Farmer’s Practice	6.25	6.49	6.37	3.85	3.90	3.88	10.25
T <sub>2</sub> – Farmer’s Practice + Zn	6.30	6.60	6.45	3.95	3.99	3.97	10.42
T <sub>3</sub> – Recommended Practice	6.20	6.67	6.44	4.15	4.18	4.17	10.61
T <sub>4</sub> – Recommended Practice + Zn	6.25	6.98	6.62	4.50	4.60	4.55	11.17
T <sub>5</sub> – Recommendation on the basis of soil test+Zn	6.10	7.60	6.85	4.61	4.70	4.66	11.51
T <sub>6</sub> – Control (No fert.)	5.45	5.26	5.36	2.75	3.00	2.88	8.24
Mean	6.09	6.80	6.45	3.97	4.06	4.06	10.47
S.Em ±	0.115	0.117	0.116	0.108	0.110	0.109	0.112
C.D. (P=0.05)	0.244	0.249	0.247	0.230	0.234	0.232	0.238

**Effect of manuring on the system economic outturn**

In rice-rice cropping system, net return (Rs. 19,996 ha<sup>-1</sup> year<sup>-1</sup>) and return per rupee investment (Rs. 1.51) were maximum when the crop received nutrients on the basis of soil test in both the seasons

in a year (Table 7). Nagalika *et al.* (1999) reported the similar trend of result. It was closely followed by the treatment where 100 % recommended doses of nutrients were applied along with zinc (net return and return per rupee investment were Rs. 19,298 ha<sup>-1</sup> year<sup>-1</sup> and Rs. 1.51, respectively).

**Table 7 : Economic analysis of rice-rice cropping sequence (Rs. ha<sup>-1</sup> year<sup>-1</sup>)**

Treatments	Cost of cultivation except cost of fert. (Rs.)	Treatment cost (Rs.)	Total cost (Rs.)	Gross return (Rs.)	Net return (Rs.)	Return per rupee investment (Rs.)
T <sub>1</sub>	33028.78	5689.00	38712.78	48600.00	9887.22	1.26
T <sub>2</sub>	33028.78	5982.00	39010.78	53820.00	14809.22	1.38
T <sub>3</sub>	33028.78	4433.00	37461.78	55800.00	18338.22	1.49
T <sub>4</sub>	33028.78	4793.00	37821.78	57120.00	19298.22	1.51
T <sub>5</sub>	33028.78	6255.00	39283.00	59280.00	19996.22	1.51
T <sub>6</sub>	33028.78	-	33028.78	37860.00	4836.22	1.15

**Table 8 : Nutrient status of soil after harvesting of each crop under rice-rice sequence**

Treatments	Total N (%)			
	Boro 2004-05	Kharif 2005	Boro 2005-06	Kharif 2006
T <sub>1</sub> – Farmer’s Practice	0.045	0.040	0.038	0.037
T <sub>2</sub> – Farmer’s Practice + Zn	0.045	0.040	0.038	0.037
T <sub>3</sub> – Recommended Practice	0.044	0.042	0.040	0.039
T <sub>4</sub> – Recommended Practice + Zn	0.044	0.042	0.040	0.039
T <sub>5</sub> – Recommendation on the basis of soil test + Zn	0.045	0.043	0.042	0.040
T <sub>6</sub> – Control (No fert.)	0.040	0.036	0.032	0.030
Treatments	Available P (kg ha <sup>-1</sup> )			
	Boro 2004-05	Kharif 2005	Boro 2005-06	Kharif 2006
T <sub>1</sub> – Farmer’s Practice	16.90	17.00	17.10	17.20
T <sub>2</sub> – Farmer’s Practice + Zn	16.90	17.10	17.50	17.60
T <sub>3</sub> – Recommended Practice	17.00	17.20	17.60	17.70
T <sub>4</sub> – Recommended Practice + Zn	17.10	17.25	17.70	17.80
T <sub>5</sub> – Recommendation on the basis of soil test + Zn	17.25	17.40	17.45	17.50
T <sub>6</sub> – Control (No fert.)	15.12	15.00	14.50	14.00
Treatments	Available K (kg ha <sup>-1</sup> )			
	Boro 2004-05	Kharif 2005	Boro 2005-06	Kharif 2006
T <sub>1</sub> – Farmer’s Practice	126.50	127.00	127.50	127.60
T <sub>2</sub> – Farmer’s Practice + Zn	126.50	127.10	127.51	127.65
T <sub>3</sub> – Recommended Practice	127.00	127.50	127.60	127.70
T <sub>4</sub> – Recommended Practice + Zn	127.00	127.60	127.75	127.80
T <sub>5</sub> – Recommendation on the basis of soil test + Zn	127.50	127.90	128.00	128.50
T <sub>6</sub> – Control (No fert.)	112.90	112.60	112.00	111.80

#### Nutrient status under rice-rice crop sequence

Irrespective of treatments it was observed that total nitrogen decreased and available P and K content increased slightly over initial value due to manuring under different systems (Table 8). Raju and Reddy (2000) reported the similar trend of result.

Considering the system productivity, net return, return per rupee investment and nutrient status of the soil it may be concluded that maximum production (10.05 t ha<sup>-1</sup> year<sup>-1</sup>), net return (Rs 19,996 ha<sup>-1</sup> year<sup>-1</sup>) and return per rupee investment (Rs. 1.51 ha<sup>-1</sup> year<sup>-1</sup>) were recorded when the crop received manuring on the basis of soil test under rice-rice cropping sequence.

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