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Effect of Fertilizers on the Yield and Nutrient Uptake by Transplanted Aman Rice (Binadhan-7) Grown in Two Soils of North-West Bangladesh

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Abstract: Four field experiments were carried out with Binadhan 7 at Birgonj, Dinajpur; Debigonj, Panchagarh; Kaligonj, Lalmonirhat and Pirgonj, Rangpur during T.aman (kharif II) season of 2011 in the Old Himalalayan Piedmont Plain (AEZ 1) and Tista Meander Floodplain Soils of North-West Bangladesh. The experiments were designed with eight treatments and laid out in randomized complete block design (RCBD) with three replications. The treatment combinations were: T_1 (100%STB), T_2 (T_1 + 25% N), T_3 (T_1 + 25% NP), T_4 (T_1 + 25% NK), T_5 (T_1 + 25% PK), T_6 (T_1 + 25% NPK), T_7 (75% of T_1) and T_8 (Control). Results indicated that application of different fertilizers significantly affected the grain yield at all of the four locations. The highest grain yield was found in treatment T_6 (T_1 + 25% NPK). Statistically identical yield was observed in treatments T_3, T_4 and T_5 at Dinajpur; T_3 at Panchagar; T_2, T_3, and T_4 at Lalmonirhat and T_2 at Rangpur. All the treatment combinations gave significantly higher grain yield over the control at all of the locations. The highest straw yield was found in treatment T_6 (T_1 + 25% NPK). Statistically identical straw yield was found in T_3 and T_4 at Dinajpur; T_1, T_4 and T_5 at Panchagar; T_2, T_4, T_5 and T_7 Lalmonirhat and all treatments except T_7 and T_8 at Rangpur. Significantly the lowest yield was obtained in the control treatment (T_8) in all of the locations. The highest total N uptake was observed in treatment T_6 at all of the four locations. For total P uptake, the similar trend of total N uptake was observed for all the locations. Treatment T_6 showed the highest uptake of total K at all locations. The highest uptake of total S was observed in treatment T_6 at Dinajpur, Panchagarh and Lalmonirhat. But the highest uptake of total S was observed in treatment T_3 at Rangpur. However, the lowest total N, P, K and S uptake was observed in control treatment (T_8) at all locations. The partial budget analysis of T.aman rice demonstrated the highest net benefit of tkha^{-1} 85,598/-, 78,619/-, 58,308/- and 72,532/- in T_6 treatment followed by tkha^{-1} 76,348/- in T_4 treatment, 71,100/- in T_3 treatment, 54,192/- in T_3 treatment and 68,247/- in T_2 treatment where the highest MBCR of 5.40, 3.75, 2.20 and 3.84 was also observed in T_6 treatment at Dinajpur, Panchagarh, Lalmonirhat and Rangpur, respectively. Based on most profitable treatments, fertilizer doses of $N_{80}P_8K_{40}S_8Zn_1$ in Birgonj, Dinajpur; $N_{84}P_8K_{40}S_6Zn_1$ in Debigonj, Panchagarh; $N_{80}P_8K_{40}S_6Zn_1$ in Kaligonj, Lalmonirhat and $N_{81}P_8K_{35}S_8Zn_1$ in Pirgonj, Rangpur could be recommended for higher yield of Binadhan-7 rice in North-West Bangladesh.

Key words: Fertilizers, Binadhan-7, Yield, Kharif II season and North-West Bangladesh.

Introduction

The soil fertilizer system in modern agriculture is getting more and more systematic and technical throughout the world. Application of imbalanced chemical fertilizers, non-recycling of organic matter to soil, continued cultivation of HYV crops, inadequate management practices etc. are associated with depletion of soil fertility in Bangladesh. A huge quantity of nutrients removed from most of the floodplains and large portion of the terrace soils with the intensification of agriculture in Bangladesh. As a result the level of soil fertility is diminishing gradually reflecting the needs of more fertilizer application in the soil for sustaining crop productivity. Deficiency of a number of macro and micro nutrients viz. nitrogen, phosphorus, potassium sulphur, zinc, boron and molybdenum etc. has already been reported from different parts of the country. Such deficiencies might be occurred due to inefficient fertilizer management by the farmers.

A sound soil testing program for rational and judicious fertilizer use to obtain desired crop response must be based on critical soil fertility limits of different nutrient elements in soil of the particular area. Soil testing has been recognized as an effective tool for determining fertilizer need of crop under all situations, and its importance is by far greatest practical value for fertilizers as scarce and costly commodity with respect to the farmers' investment ability.

Balanced fertilization in modern intensive high yielding cropping systems is prerequisite for the environment and sustaining agricultural production. Therefore, it is a challenge to develop environment friendly and economically suitable combinations of inorganic and organic fertilizers for sustaining soil fertility with higher crop productivity. Supplying adequate amounts of mineral nutrients to crops is one of the most important factors in achieving higher productivity (Fageria *et al.*, 1991). The amount of nutrient taken up by a crop is closely related to the total amount of biomass it produces. In general, higher the yield level higher is the amount of nutrient removed by the crop (Bhuiyan, 1993).

Fertilizer is a key component in the agricultural production systems of Bangladesh. Its use efficiency is becoming much more important in the market economy of agriculture products. Present level of fertilizer use in farmers' fields shows under or over use of recommended fertilizer doses. It requires farm level investigation to find out reasons for such gap between the recommended doses and farmers' actual practices. It is, therefore, necessary for judicious

application of fertilizers not only for increasing crop production but also maintaining soil fertility and environment.

Materials and Methods

Description of the experimental sites

Four field experiments were carried out at Birgonj, Dinajpur; Debigonj, Panchagarh; Kaligonj, Lalmonirhat and Pirgonj, Rangpur during T.aman (kharif II) season of 2011 using Binadhan-7 as test crop in the Old Himalalayan Piedmont Plain (AEZ 1) and Tista Meander Floodplain (AEZ 3) soils of North-West Bangladesh. The climatic condition of the experimental area is sub-tropical monsoon as prevailed in the other portion of the country.

Collection and analysis of initial soil samples

Initial soil samples were collected from the different experimental sites. After collecting soil sample, the unwanted materials like gravels, plant roots, leaves etc., were picked up and removed. Then the samples were air dried, well mixed and ground to pass through a 20 mesh sieve and stored in clean plastic bags for physical and chemical analysis. Soil samples were analyzed following standard methods, viz.: particle size distribution by a hydrometer, soil pH by glass electrode pH meter, organic matter by wet oxidation and total nitrogen by micro-Kjeldahl method, available phosphorus and available sulphur were extracted from soil by dilute acid solutions and determined by a spectrophotometer, exchangeable potassium was extracted with ammonium acetate solution and was determined by a flame photometer. The physico-chemical properties of the experimental soils are presented in Table 1.

Table 1. Initial soil characteristics of the soils under study

Soil properties	Birgonj (Dinajpur)	Debigonj (Panchagarh)	Kaligonj (Lalmonirhat)	Pirgonj (Rangpur)
Sand (%)	61.6	63.6	59.4	43.6
Silt (%)	22.0	20.0	24.0	30.0
Clay (%)	16.4	16.4	16.4	26.4
Texture	Sandy loam	Sandy loam	Sandy loam	Loam
pH	5.4	5.4	5.3	5.6
OM (%)	1.74	1.20	1.74	1.35
TN (%)	0.087	0.060	0.087	0.068
Avail. P (ppm)	25.5	16.6	31.6	20.1
Avail. S (ppm)	12.0	21.9	19.1	11.2
Exch. K (me%)	0.09	0.09	0.11	0.13

Collection and analysis of grain and straw samples

Grain and straw samples were collected during harvesting period. Grain and straw samples were dried in an oven at about 65°C for 48 hours and then ground in a grinding mill to pass through a 20 mesh sieve. The ground grain and straw samples were stored in small paper bags and placed in desiccators for the analysis of different elements. The grain and straw samples were analyzed for the determination of N, P, K and S contents.

An amount of 0.5 g of oven dried ground plant sample was taken in a micro-kjeldahl flask. Then 1.1 g of catalyst mixture (K_2SO_4: $CUSO_4$: $5H_20$: Se powder =100: 10: 1), 3 ml of 30% $HClO_4$ and 5ml of conc. H_2SO_4 were added in the flask. The flask was swirled and allowed to stand for about 1.5-2 hours. Then the flask was heated on an electric hot plate for heating at 150^0 C and continued until the digest become colorless. After cooling the digest was transferred into a 100 ml volumetric flask and the volume was made up to the mark wide distilled water. A reagent blank was prepared similarly. From the digests, nitrogen was determined.

An amount of 0.5 g oven-dry, ground samples (straw and grain) was taken in a digestion flask. 8 ml of di-acid mixture (HNO_3: $HC1O_4$ in the ratio 5:3) was added into flask and kept for 1 hour. Then the flask was heated on an electric hot plate for heating at 150^0 C and continued until the digest become colorless. After cooling the digest was transferred into a 50 ml volumetric flask and the volume was made up to mark with distilled water. From the digests, plant P, K and S were determined.

Transplanting, fertilization and intercultural operations

The land was well prepared before transplantation. After uniformly leveling, the experimental plots were laid out in randomized complete block design (RCBD) with three replications. The unit plots area was 5mx4m. Eight treatment combinations of fertilizers were used in the experiments. The sources of N, P, K, S and Zn were urea, TSP, MoP, gypsum and zinc oxide, respectively. Three healthy seedlings of Binadhan-7 rice of 25-30 days old were transplanted per hill in the plots. Fertilizers were applied to each plot as per treatment. The full dose of all fertilizers except urea was applied as basal to each individual plots during final land preparation. The fertilizers were incorporated into the soils. The first split (1/3) of N was applied within 10 days after transplanting. The second split (1/3) of N was applied at maximum vegetative growth stage and incorporated

with the soil. The third split (1/3) of N was applied at or before P.I. stages. Pest control and other intercultural practices like irrigation, etc. were given as and when necessary.

Statistical analysis

The recorded data were compiled and tabulated properly. The recorded data were statistically analyzed to find out the significance of variance resulting from the experimental treatments on various plant characters. Analysis of Variance (ANOVA) was done following RCBD with the help of a computer package program MSTAT and mean differences were adjudged by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

Yield contributing characters

Results of plant height, panicle length, number of tillers per hill and 1000 grain weight were recorded and the data are shown in Table 2a to Table 2b. Plant height of Binadhan-7 was significantly influenced by the fertilizer treatments. It revealed that all the treatments produced significantly taller plants compared to the control treatment (T_1) at all the locations. However, the plant height ranged from 93.3 to 99.9cm at Birgonj, Dinajpur; 80.2 to 91.3cm at Debigonj, Panchagarh; 82.6 to 92.5cm at Kaligonj, Lalmonirhat and 89.1 to 99.3cm at Pirgonj, Rangpur. The plant height was comparatively taller at Birgonj and Pirgonj than that was observed at Debigonj and Kaligonj. These variations in plant height might be due to the local variations in soil characteristics along with the interactions of the different fertilizer nutrients. The different treatment combinations of fertilizers significantly influenced the panicle length of Binadhan-7. However, the panicle length was found more or less identical at all the locations. The lowest panicle length was observed in treatment T_1 (control). Like Plant height and panicle length, the number of effective tillers per hill was significantly influenced by the fertilizer treatments. However, the higher number of tillers was observed at Birgonj and Debigonj than that was observed at Kaligonj and Pirgonj. These variations in number of tillers per hill also might be due to the local variations in soil characteristics with the interactions of the different fertilizer nutrients. There was no significant effect of different fertilizer treatment combinations was observed in the case of 1000-grain weight of Binadhan-7 grown at four locations in North-West Bangladesh. However, the 1000 grain weight was found lowest in treatment T_1 (control) at all the locations. Similar results of plant height, panicle length, number of effective tillers per hill and 1000 grain weight were also reported by Jadhav *et al*. (2006), Rahman *et al*. (2007), Islam *et al*. (2008).

Table 2a. The effects of different treatments on plant height, panicle length, tillers hill^{-1} and 1000 seed weight of Binadhan 7 at Birgonj, Dinajpur and Debigonj, Panchagar

Treatments	Birgonj, Dinajpur				Debigonj, Panchagar			
	Plant height (cm)	Panicle length (cm)	Tillers/hill (No.)	1000 seed wt. (gm)	Plant height (cm)	Panicle length (cm)	Tillers/hill (No.)	1000 seed wt. (gm)
T_1 (100%STB*)	99.13a	23.47a	09.73d	23.93	85.73c	22.20abc	10.27cd	22.52
T_2 (T_1 + 25% N)	97.80ab	23.07ab	12.47a	22.89	87.53bc	23.07ab	10.20cd	20.91
T_3 (T_1 + 25% NP)	98.00ab	22.27bc	10.53c	24.17	88.33abc	22.27abc	11.40bc	20.95
T_4 (T_1 + 25% NK)	96.40b	23.13ab	10.67c	23.47	91.27a	23.17a	11.00ab	21.77
T_5 (T_1 + 25% PK)	99.27a	24.00a	10.00cd	24.16	85.20c	22.93ab	11.93ab	21.62
T_6 (T_1 + 25% NPK)	99.93a	23.40a	10.53c	23.22	90.67ab	22.07abc	12.33a	21.55
T_7 (75% of T_1)	98.27ab	23.33a	09.53d	23.65	88.33abc	21.87bc	10.33cd	20.28
T_8 (Control)	93.33c	21.53c	11.67b	22.64	80.20d	21.53c	09.67d	21.22
CV (%)	1.25	2.44	3.60	0.486	2.02	2.94	4.74	0.03

* Birgonj, Dinajpur: $T_1 = N_{64}P_6K_{32}S_8Zn_1$; Debigonj, Panchagarh: $T_1 = N_{67}P_6K_{32}S_6Zn_1$; Kaligonj, Lalmonirhat: $T_1 = N_{64}P_6K_{32}S_6Zn_1$ and Pirgonj, Rangpur: $T_1 = N_{65}P_6K_{28}S_8Zn_1$.

Table 2b. The effects of different treatments on plant height, panicle length, tillers hill^{-1} and 1000 seed weight of Binadhan 7 at Kaligonj, Lalmonirhat and Pirgonj, Rangpur

Treatments	Kaligonj, Lalmonirhat				Pirgonj, Rangpur			
	Plant height (cm)	Panicle length (cm)	Tillers hill^{-1} (No.)	1000 seed wt. (gm)	Plant height (cm)	Panicle length (cm)	Tillers hill^{-1} (No.)	1000 seed wt. (gm)
T_1 (100%STB*)	91.93b	24.87	08.33ab	21.74	96.40ab	24.67a	08.73a	22.57
T_2 (T_1 + 25% N)	89.67b	24.13	08.27ab	21.37	97.33ab	24.13ab	08.60a	23.10
T_3 (T_1 + 25% NP)	91.87b	24.20	08.27ab	22.08	99.33a	24.67a	07.60bc	23.20
T_4 (T_1 + 25% NK)	97.67a	24.67	09.00a	21.91	97.47ab	24.53a	08.73a	23.18
T_5 (T_1 + 25% PK)	90.13b	24.47	08.13ab	22.01	96.60ab	24.93a	08.13ab	23.13
T_6 (T_1 + 25% NPK)	92.53b	24.40	08.87ab	21.93	96.47ab	24.20ab	08.60a	23.02
T_7 (75% of T_1)	90.33b	24.93	07.47bc	22.00	95.60b	24.27a	08.47a	22.39
T_8 (Control)	82.60c	23.47	06.27c	20.92	89.07c	23.33b	07.40c	21.89
CV (%)	2.5	2.33	9.49	0.74	1.74	1.98	4.56	0.46

- STB = Same as in Table 2a.

Grain and straw yield

Results indicated that grain yield of Binadhan-7 rice was significantly affected by the application of different fertilizers (Table 3). The highest grain yield was found in treatment T_6 (T_1 + 25% NPK). Statistically identical yield was observed in treatments T_3, T_4 and T_5 at Birgonj, Dinajpur; T_3 at Debigonj, Panchagar; T_2, T_3, and T_4 at Kaligonj, Lalmonirhat and T_2 at Pirgonj, Rangpur. All the treatment combinations gave significantly higher grain yield over the control at all of the four locations. Similar results were also reported earlier by Annadurai *et al*. (2000).

Straw yield of Binadhan-7 was also significantly influenced by the different combinations of fertilizer treatments (Table 3). The highest straw yield was found in treatment T_6 (T_1 + 25% NPK). Statistically identical yield was found in T_3 and T_4 at Birgonj, Dinajpur; T_1, T_4 and T_5 at Debigonj, Panchagar; T_2, T_4, T_5 and T_7 at Kaligonj, Lalmonirhat and all treatments except T_7 and T_8 at Pirgonj, Rangpur. Significantly the lowest yield was obtained in the control treatment (T_8) in all of the locations. Similar result was recorded by Singh *et al.* (2000) who observed that inorganic fertilizer combinations encouraged vegetative growth and thereby increased straw yield.

Table 3. Effects of fertilizers on yield of T. aman rice (Binadhan-7) during Kharif-II season, 2011at Birgonj, Dinajpur; Debigonj, Panchagar; Kaligonj, Lalmonirhat and Pirgonj, Rangpur

Treatments	**Birgonj, Dinajpur**		**Debigonj, Panchagar**		**Kaligonj, Lalmonirhat**		**Pirgonj, Rangpur**	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
				t ha^{-1}				
T_1 (100%STB*)	3.93c	4.53c	4.07cd	6.30ab	3.24bcd	3.56bc	4.14c	4.85ab
T_2 (T_1 + 25% N)	4.37bc	5.87b	4.30bcd	6.03b	3.58abc	4.40ab	4.63ab	5.12a
T_3 (T_1 + 25% NP)	5.03ab	6.10ab	4.80ab	6.03b	3.81ab	3.77bc	4.37bc	4.69ab
T_4 (T_1 + 25% NK)	5.13ab	6.47ab	4.23bcd	6.73ab	3.65abc	4.27ab	4.55b	5.19a
T_5 (T_1 + 25% PK)	4.93ab	5.47bc	4.37bc	6.37ab	3.31bcd	3.95ab	4.34bc	4.69ab
T_6 (T_1 + 25% NPK)	5.72a	7.07a	5.27a	6.90a	4.05a	4.72a	4.97a	5.06a
T_7 (75% of T_1)	3.73c	4.43c	3.67de	4.83c	3.01cd	3.88ab	3.45d	4.35bc
T_8 (Control)	2.87d	3.27d	3.17e	3.60d	2.64d	2.98c	2.77e	3.80c
CV (%)	10.89		8.49	6.53	10.71	11.42	4.97	7.48

* STB = Same as in Table 2a.

Total Nutrient uptake

Both grain and straw of Binadhan-7 rice were analyzed for the determination of N, P, K and S concentrations. The total uptakes of these nutrients were also calculated from the yield and the nutrient concentration of grain and straw. The total nutrient uptake by Binadhan 7 at different locations was influenced due to different treatments (Table 4a to Table 4b). The highest total N uptake was observed in treatment T_6 at all of the studied locations. Prudente *et al*. (2008) found approximately 1.4% increase in the total N uptake for every additional kilogram of applied N ha^{-1}. Phosphorus uptake by grain and straw were significantly influenced by the application of different levels of P (Sayeeduzzaman, 2008 and Rahman, 2008). Treatment T_6 showed the highest uptake of total K at all locations. Nagarathna and Prakasha (2007) revealed that the application of potassium 60% as basal and 40% at maximum tiller stage significantly increased the total K uptake. The highest uptake of total S was observed in treatment T_6 at Birgonj, Dinajpur; Debigonj, Panchagarh and Kaligonj, Lalmonirhat. But the highest uptake of total S was observed in treatment T_3 at Pirgonj, Rangpur. However, the lowest total N, P, K and S uptake was observed in control treatment (T_8) at all locations. Uddin (2008) found that total S content and uptake by grain and straw were significantly influenced by the application of different levels of sulphur.

Table 4a. Effects of fertilizers on total nutrient uptake (kg/ha) by T. aman rice (Binadhan-7) during Kharif-II season, 2011 at Birgonj, Dinajpur and Debigonj, Panchagar

Treatments	Birgonj (Dinajpur)				Debigonj (Panchagarh)			
	N	P	K	S	N	P	K	S
T_1= (100%STB*)	83	14.6	88	8.3	73	11.7	68	8.0
$T_2 = T_1 + 25\%$ N	82	14.8	108	8.6	84	13.1	90	9.0
$T_3 = T_1 + 25\%$ NP	93	14.3	94	9.6	100	14.1	89	9.6
$T_4 = T_1 + 25\%$ NK	91	15.6	116	8.5	104	16.6	97	10.4
$T_5 = T_1 + 25\%$ PK	86	14.3	96	9.2	98	14.0	90	9.6
$T_6 = T_1 + 25\%$ NPK	103	17.4	133	10.6	111	19.8	109	10.0
$T_7 = 75\%$ of T_1	74	12.2	89	6.4	68	10.3	68	7.9
T_8 = Control	50	7.4	47	4.7	45	07.7	44	4.6

- STB = Same as in Table 2a

Table 4b. Effects of fertilizers on nutrient uptake (kg ha^{-1}) by T. aman rice (Binadhan-7) during Kharif-II season, 2011 at Kaligonj, Lalmonirhat and Pirgonj, Rangpur

Treatments	Kaligonj (Lalmonirhat)	Pirgonj (Rangpur)						
	N	P	K	S	N	P	K	S
T_1= (100%STB*)	61	8.3	75	5.0	79	11.5	75.4	6.6
$T_2 = T_1 + 25\%$ N	64	11.2	74	5.9	89	12.5	89.5	7.2
$T_3 = T_1 + 25\%$ NP	67	10.9	60	6.2	76	10.7	78.5	7.4
$T_4 = T_1 + 25\%$ NK	73	11.0	92	5.5	86	12.1	93.8	6.8
$T_5 = T_1 + 25\%$ PK	61	9.6	77	5.3	76	12.4	74.8	6.6
$T_6 = T_1 + 25\%$ NPK	77	11.7	101	6.3	92	14.0	98.3	7.2
$T_7 = 75\%$ of T_1	53	7.8	68	5.1	61	10.9	73.3	5.8
T_8 = Control	38	6.8	43	3.3	47	6.6	53.5	3.8

* STB = Same as in Table 2a

Economics of fertilizers use

The results of partial budget analysis of T.aman rice (Table 5a to Table 5b) demonstrated that the highest net benefit of Tk. ha^{-1} 85,598, 78,619, 58,308 and 72,532 was obtained in T_6 treatment followed by Tkha^{-1} 76,348 in T_4 treatment, 71,100 in T_3 treatment, 54,192 in T_3 treatment and 68,247 in T_2 treatment at Birgonj, Dinajpur; Debigong, Panchagarh; Kaligong, Lalmonirhat and Pirgonj, Rangpur. Another attempt also been made to find out the marginal benefit cost ratio (MBCR) against the treatments, which is also shown in Table 5a to Table 5b. The highest MBCR of 5.40, 3.75, 2.20 and 3.84 was obtained in T_6 treatment followed by 4.25 in T_4 treatment, 2.89 in T_2 treatment, 1.73 in T_3 treatment and 3.52 in T_2 treatment at Birgonj, Dinajpur; Debigong, Panchagarh; Kaligong, Lalmonirhat and Pirgonj, Rangpur respectively.

Table 5a. Partial budget analysis for fertilizer use in T. aman rice (Binadhan-7) during Kharif-II season, 2011 at Birgonj, Dinajpur and Debigonj, Panchagar

Treatment	Birgong, Dinajpur					Debigong, Panchagarh				
	Gross return	Fert. cost	Net return	Marginal return	MBCR	Gross return	Fert. cost	Net return	Marginal return	MBCR
	Tk. ha^{-1}									
T_1= (100%STB*)	63480	5927	57553	11233	1.90	67350	5952	61398	10248	1.72
$T_2 = T_1 + 25\%$ N	71420	6647	64773	18453	2.78	70530	6705	63825	12675	1.89
$T_3 = T_1 + 25\%$ NP	81550	6872	74678	28358	4.13	78030	6930	71100	19950	2.88
$T_4 = T_1 + 25\%$ NK	83420	7072	76348	30028	4.25	70180	7106	63074	11924	1.68
$T_5 = T_1 + 25\%$ PK	79420	6552	72868	26548	4.05	71920	6577	65343	14193	2.16
$T_6 = T_1 + 25\%$ NPK	92870	7272	85598	39278	5.40	85950	7331	78619	27469	3.75
$T_7 = 75\%$ of T_1	60380	4445	55935	9615	2.16	59880	4464	55416	4266	0.96
T_8 = Control	46320	0	46320	-	-	51150	0	51150	-	-

* STB = Same as in Table 2a

Table 5b. Partial budget analysis for fertilizer use in T. aman rice (Binadhan-7) during Kharif-II season, 2011 at Kaligonj (Lalmonirhat) and Pirgonj (Rangpur)

Treatment	Kaligong (Lalmonirhat)					Pirgonj (Rangpur)				
	Gross return	Fert. cost	Net return	Marginal return	MBCR	Gross return	Fert. cost	Net return	Marginal return	MB CR
					Tk. ha^{-1}					
T_1= (100%STB*)	52160	5817	46343	3763	0.65	66950	5772	61178	15828	2.74
$T_2 = T_1$ + 25% N	58100	6537	51563	8983	1.37	74750	6503	68247	22897	3.52
$T_3 = T_1$ + 25% NP	60920	6728	54192	11612	1.73	70240	6728	63512	18162	2.70
$T_4 = T_1$ + 25% NK	59020	6937	52083	9503	1.37	73440	6853	66587	21237	3.10
$T_5 = T_1$ + 25% PK	53600	6442	47158	4578	0.71	69790	6347	63443	18093	2.85
$T_6 = T_1$ + 25% NPK	65470	7162	58308	15728	2.20	79610	7078	72532	27182	3.84
T_7 = 75% of T_1	49030	4663	44367	1787	0.38	56100	4329	51771	6421	1.48
T_8 = Control	42580	0	42580	-	-	45350	0	45350	-	-

* STB = Same as in Table 2a

Conclusion

The highest yield, nutrient uptake and net benefit was found in treatment T_6 (T_1 + 25% NPK) at all of the four locations under the study. Based on most profitable treatments, fertilizer doses of $N_{80}P_8K_{40}S_8Zn_1$ in Birgonj, Dinajpur; $N_{84}P_8K_{40}S_6Zn_1$ in Debigonj, Panchagarh; $N_{80}P_8K_{40}S_6Zn_1$ in Kaligonj, Lalmonirhat and $N_{81}P_8K_{35}S_8Zn_1$ in Pirgonj, Rangpur could be recommended for higher yield of Binadhan-7 rice in North-West Bangladesh.

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