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EFFECTS OF REDUCED RATES OF FERTILIZER ON BRRI DHAN28

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Abstract: The experiment was conducted at the Soil Science farm of Bangladesh Agricultural University, Mymensingh, Bangladesh during boro season to study the effects of reduced rates of fertilizer on performance of BRRI dhan28. There were eight treatments such as T_1: control, T_2: Recommended Fertilizer Dose (RFD), T_3:50% RFD, T_4:60% RFD, T_5:70% RFD, T_6:80% RFD, T_7: 90% RFD, and T_8:120% RFD. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The recommended fertilizer doses were100 kg N ha^{-1}, 15 kg P ha^{-1}, 50 kg K ha^{-1}, 15 kg S ha^{-1} and 1.5 kg Zn ha^{-1}. Nitrogen, P, K, S and Zn were supplied through urea, TSP, MoP, gypsum and zinc sulphate, respectively. The grain and straw yield as well as biological yield of BRRI dhan28 were significantly affected due to different treatments. The highest grain yield of 6.35 t ha^{-1} and straw yield of 7.81 t ha^{-1}were observed in the treatment T_8 containing 120% RFD which was statistically identical to those recorded in the treatments T_2 (RFD), T_5 (70% RFD), T_6 (80% RFD) and T_7 (90% RFD). Grain yield was positively correlated with plant height, tillers $hill^{-1}$, panicle length, filled grains $panicle^{-1}$ and 1000-grain weight whereas negatively correlated with unfilled grain $panicle^{-1}$. Application of at best 30% reduction of all the fertilizers from recommended fertilizer dose affect non-significantly both in nutrient content and nutrient uptake by grain and straw of BRRI dhan28 compared to the treatment T_2 (RFD). In the experiment 120% of recommended fertilizer dose performed better than other treatments and 30% reduction of all the fertilizers from recommended fertilizer dose did not differ significantly compared to the treatment T_2 (RFD). The obtained result clearly indicated that if anyone wants to increase the crop yield then he may practice 120% RFD but this variety may be cultivated by 30% reduction of all the fertilizers from recommended fertilizer dose without affecting yield.
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1. Introduction

Rice is one of the most extensively cultivated cereals of the world and it is also the principal food crop of Bangladesh. The area and production of rice were 11.35 million hectares and 31.97 million tons, respectively (BBS, 2010). Asia as a whole contributes about 90 percent of the world rice harvest. Bangladesh, China, India, Indonesia, Myanmar, Philippines, Thailand and Vietnam are producing more than 90 percent of total Asian rice production (Food Outluck, 2007). Among the major rice growing countries of the world, Bangladesh ranks third in respect of growing area and fourth in respect of production.

Soil is the principal supplier of plant nutrients. Plant derives 13 essential nutrients out of 17 from the soil. But soil varies considerably in their inherent capacities to supply nutrients, which are gradually declining over time due to intensive cropping with high yielding rice varieties. Nitrogen, phosphorus, potassium and sulphur are the macronutrients and can play a key role to increase the production of rice to a great extent. Arivazhagan and Ravichandran (2005) reported that application of 150:50:75 kg NPK ha-1 resulted in the highest number of panicles hill-1, panicle length, 1000-grain weight, grain yield and straw yield. On the other hand zinc is considered as micronutrients for rice cultivation.

Depletion of soil fertility is a major constraint for higher crop production in Bangladesh and indeed, yield of several crops is declining in some soils. Soil fertility maintenance is very essential in achieving and maintaining high crop yields over a period of time. There is need to apply fertilizers to maintain soil fertility. Fertilizer is an important input that contributes to crop production. It increases the productivity of the soil for plant growth and improves the quantity and quality of produce.

Apart from the economic cost, the use of chemical fertilizers under continuous cultivation in the tropics is not adequate to sustain crop yield. Use of chemical fertilizers are also expensive and a threat to human health (Weltzein, 1990). So, it is suggested that there should be an emphasis on finding rational fertilizer dose for better yield. The use of these rational fertilizers has a role in the management of plant diseases and soil fertility. Use of optimum fertilizers not only maintains soil health and sustainable agriculture but also it becomes ecologically sound, environmentally friendly and economically feasible. Considering the above points, the present study was undertaken to evaluate the effects of reduced rates of fertilizer on the yield, yield contributing characters and nutrient uptake of BRRI dhan28.

2. Material and Methods

Experimental site, soil and climate

The experiment was conducted at the Soil Science farm of Bangladesh Agricultural University, Mymensingh, Bangladesh during boro season. The experimental field is situated at the latitude of 24.74^0 N and longitude 90.50^0 E. The physical and chemical characteristics of the soil of experimental field are given in Table 1.

Table-1: Physical and chemical properties of the initial soil

Characteristics	**Value**
% Sand	12.52
% Silt	72.46
% Clay	15.02
Textural class	Silt loam
Chemical characteristics	
pH	6.39
Organic matter (%)	3.25
Total N (%)	0.168
Available P (ppm)	14.76
Exchangeable K (me 100 g^{-1} soil)	0.13
Exchangeable Na (me 100 g^{-1} soil)	0.297
Exchangeable Ca (me 100 g^{-1} soil)	6.09
Available S (ppm)	12.47

Treatments and crop culture

The used BRRI dhan28 was released by the Bangladesh Rice Research Institute (BRRI). The experiment was laid out in randomized complete block design (RCBD) with three replications. There were eight treatments such as T_1: control, T_2: Recommended Fertilizer Dose (RFD), T_3: 50% RFD, T_4: 60% RFD, T_5: 70% RFD, T_6: 80% RFD, T_7: 90% RFD, and T_8: 120% RFD. Recommended Fertilizer Dose (RFD) = 100 kg N ha^{-1} + 15 kg P ha^{-1} + 50 kg K

ha^{-1} + 15 kg S ha^{-1} and 1.5 kg Zn ha^{-1}. The P, K, S, and Zn were applied @ 20, 50 and 10 kg ha^{-1} from triple super phosphate (TSP), muriate of potash (MOP), gypsum and zinc sulphate, respectively during final land preparation. Urea was applied in three equal split; one-third 10-15 days after transplanting, second installment after 30-35 days of transplanting i.e. at maximum tillering stage and third installment after 50-55 days of transplanting i.e. at panicle initiation stage or booting stage of crop. Three seedlings of 35 day old were transplanted in the plots keeping plant spacing 20 cm x 20 cm. After transplanting 5-6 cm water was maintained in each plot throughout the growth period. Weeds were controlled by uprooting and removing them from the field at two times. The crop was harvested at full maturity then harvested crop was threshed plot wise. Ten hills were randomly selected from each plot at maturity to record yield contributing characters like plant height, number of tillers $hill^{-1}$, panicle length, number of grains $panicle^{-1}$and 1000-grain weight. Grain and straw yields were recorded plot wise and expressed as t ha^{-1} on sundry basis. Grain and straw sub-samples were kept for chemical analysis.

Chemical analysis of soils

The initial soil sample was collected before land preparation from the plough depth layer (0-15 cm). The composite sample was air dried, ground and sieved through a 20-mesh sieve and stored in a plastic bag for physical and chemical analysis. Particle size analysis of soil was done by hydrometer method (Black, 1965) and the textural class was determined by plotting of values for % sand, % Silt and % clay to the Marshall's triangular coordinate following the USDA system. Soil pH was measured with the help of a glass electrode pH meter using soil water suspension of 1:2:5 as described by Jackson (1962). Organic matter content of soil samples were estimated following the method developed by Walkey and Black (1934). The organic carbon contents were then calculated by multiplying the percent organic carbon with the Van-Bemmelen factor 1.724 (Page *et al.,* 1989). The total nitrogen of soil samples was determined following micro-Kjeldahl method outlined by Jackson (1962). Exchangeable K, Na and Ca were determined by flame photometer on the neutral ammonium acetate extract (Black, 1965). Available sulphur in soil was determined by extracting the soil samples with 0.15 % $CaC1_2$ solution (Page *et al*., 1989).

Chemical analysis of grain and straw

The representative grain and straw samples were dried in an oven at 65°C for about 24 hours before they were ground by a grinding machine. Then the ground samples were passed through a 20-mesh sieve and stored in paper bags and finally they were kept in desiccators. Total N, P, K, and S contents of plant were determined after H_2SO_4-H_2O_2 digestion method described by Lu *et al*. (1999). Then nutrient (NPKS) uptake was calculated by the following formula: Nutrient uptake (kg ha^{-1}) = (Gy × N_{Gr})/ 100 + (Sy × N_{st})/100; where, Gy = Grain yield (kg ha^{-1}), Sy = Straw yield (kg ha^{-1}), N_{Gr} = N content in grain (%), N_{St} = N content in straw (%).

Statistical analysis

The analysis of variance for various crop characters and also for various nutrients concentrations and nutrient uptake were done following the F-test. Mean comparisons of the treatments were made by the Duncan's Multiple Range Test, DMRT (Gomez and Gomez, 1984).

3. Results and Discussion

Yield components of BRRI dhan28

The plant height, effective tillers $hill^{-1}$, panicle length, number of filled grains $panicle^{-1}$, number of unfilled grains $panicle^{-1}$, of BRRI dhan28 was significantly affected due to different treatments (Table 2). Plant height varied from 72.38 to 85.34 cm. The tallest plant (85.34 cm) was recorded in the treatment T_8 (120% RFD) which was statistically similar to the treatment T_2 (RFD) with the values of 82.69 cm. The shortest plant (72.38 cm) was obtained in the treatment T_1 (control) which was statistically identical to that recorded in the treatment T_3: (50% RFD) with value 76.43 cm. The results are also in agreement with the findings of Moreno *et al.* (1985) and Mishra *et al.* (1999). The number of tillers $hill^{-1}$ due to different treatments varied from 7.95 to 11.42. The highest number of effective tillers hill-1 (11.42) was found in the treatment T_8 which was statistically similar to those recorded in the other treatments except T_1. The minimum number of tillers $hill^{-1}$ (7.95) was found in the treatment T_1. Similar results were also obtained by Balakrisnan and Natarajaratnan (1986). The panicle length of T_2 (24.29cm) is identical to the other treatment except T_1 (20.48cm).

The number of filled grains $panicle^{-1}$ of different treatments ranged from 98.40 to 122.18. The highest number of filled grains $panicle^{-1}$ 122.18 was found in the treatment T_8 which was statistically similar to those recorded in the treatments T_2, T_5, T_6 and T_7 with the values of 120.83, 118.31, 118.53 and 119.14 respectively. The lowest number of filled grains $panicle^{-1}$ (98.40) was found in the treatment T_1. These results were supported by the findings of Mondal *et al*. (1990) and Halder *et al*. (2000). The number of unfilled grains $panicle^{-1}$ varied from 11.15 to 13.32. The highest number of unfilled grains $panicle^{-1}$ (13.32) was produced by the treatment T_1. It indicates that no use of fertilizers produces the highest number of unfilled grains. The lowest number of unfilled grains panicle^{-1} (11.15) was produced by the treatment T_8 which was statistically different from all other treatments. Application of different fertilizer levels increased the 1000-grain weight of BRRI dhan28 but this increase was non-significant.

Yield of BRRl dhan28

Yield of BRRl dhan28 responded significantly to the different treatments (Table 3). The grain yield due to various treatments ranged from 3.44 to 6.35 t ha^{-1} and the straw yield ranged from 4.29 to 7.81 t ha^{-1}. The highest grain yield (6.35 t ha^{-1}) and straw yield (7.81t ha^{-1}) was obtained in the treatment T_8 (120% RFD) which was statistically similar to those observed in the treatments T_2, T_5, T_6 and T_7.

The lowest grain yield (3.44 t ha^{-1}) and (4.29 t ha^{-1}) and straw yield was obtained in the treatment T_1. The biological yield obtained from different treatments ranged from 7.73 to 14.16 t h^{-1}. The highest biological yield (14.16) was recorded in the treatment T_8 which was statistically similar to those recorded in the treatments T_2, T_5, T_6 and T_7 with values of 13.54, 12.07, 12.68 and 13.28 t ha^{-1} respectively and the lowest biological yield (7.73t ha^{-1}) was noted in the treatment T_1. The highest percentage of increased grain (84.59%), straw (82.05%) and biological yield (83.18%) over control was observed in the treatment T_8 (120% RFD). The yield obtained from different treatments ranked in the order $T_8 > T_2 > T_7 > T_6 > T_5 > T_4 > T_3 > T_1$. The results revealed that 120% RFD was more pronounced than that of other treatments under study and 30% reduction of all the fertilizers from RFD did not affect the grain yield, straw yield and biological yield significantly compared to RFD. Sarfaraz *et al.* (2002) found that the number of tillers m^{-2}, 1000-grain weight, and grain and straw yields were significantly increased with the application of NPK and S fertilizers compared to the control.

Nutrient content in grain and straw

Nitrogen content

There was significant effect of different treatments on N concentration of both rice grain and straw (Table 4). The N content varied from 1.120 to 1.419% in grain and 0.520 to 0.698% in straw. The treatment T8 (120% RFD) resulted the maximum N content in grain (1.419%) which was statistically similar to those recorded in the treatments T2, T6 and T7 with values 1.411, 1.275 and 1.378% N respectively. The highest N value (0.698%N) in straw also was found in the treatment T8. The minimum value (1.120%N) in grain and (0.520 %N) in straw was noted in the treatment T1. The 120% RFD increased the N content both in grain and straw of rice but smaller (30%) reduction of all the fertilizers affect the N content of grain and straw but non-significantly. Sarfaraz et al. (2002) found that NPK concentrations in grain and straw significantly increased with the application of NPK + S fertilizers compared to the control.

Phosphorus content

Phosphorus content in both grain and straw of BRRI dhan28 was non-significantly influenced by the different treatments (Table 4). The P content ranged in grain from 0.217 to 0.239% and in straw from 0.119% to 0.130%. The highest P value (0.239%) in grain and (0.130% P) in straw was recorded in the treatment T_8. The lowest P value (0.217%) and (0.119% P) in grain and straw was noted in the treatment T_1. The P concentration in grain was higher than that of straw in all the treatments. The result indicates that 120% RFD had pronounced effect on P content in both grain and straw but the decrease of the fertilizers from the recommended fertilizer dose did not affect significantly in P content. Similar results were also obtained by Kadu *et al.* (1991). Sarfaraz *et al.* (2002) found that P concentrations in grain and straw significantly increased with the application of NPK + S fertilizers compared to the control.

Table-2: Effects of reduced rates of fertilizer on the yield contributing characters of BRRI dhan28

Treatments	Plant height (cm)	Effective tillers $hill^{-1}$	Panicle length (cm)	Filled grains $panicle^{-1}$	Unfilled grains $panicle^{-1}$	1000-grains weight (g)
T_1 : Control	72.38d	7.95b	20.48b	98.40c	13.32	22.21
T_2 : RFD	82.69ab	11.18a	24.29a	120.83ab	11.19	22.75
T_3: 50% RFD	76.43cd	9.83a	22.97ab	116.37b	12.25	22.29
T_4: 60% RFD	78.17bc	10.12a	23.09ab	117.12b	11.53	22.23
T_5: 70% RFD	79.53bc	10.65a	23.66ab	118.31ab	11.40	22.32
T_6: 80% RFD	80.12bc	10.51a	23.57ab	118.53ab	11.48	22.58
T_7: 90% RFD	79.63bc	10.93a	24.02ab	119.14ab	11.25	22.67
T_8: 120% RFD	85.34a	11.42a	24.37a	122.18a	11.15	22.87
SE (±)	0.82	0.26	0.38	1.44	0.25	0.26

Figure (s) in a column having common letter(s) do not differ significantly at 5% level of significance and the figures which are not lettered are non significant at 5% level of significance; RFD = 100 kg N ha^{-1} + 15 kg P ha^{-1} + 50 kg K ha^{-1} + 15 kg S ha^{-1} + 1.5 kg Zn ha^{-1}.

Table- 3: Effects of reduced rates of fertilizer on the yield of BRRI dhan28

Treatments	Grain yield (t/ha)	% increased over control	Straw yield (t/ha)	% increased over control	Biological yield (t/ha)	% increased over control
T_1 : Control	3.44d	-	4.29c	-	7.73d	-
T_2 : RFD	6.03ab	75.29	7.51a	75.06	13.54ab	75.16
T_3: 50% RFD	4.65c	35.18	5.45bc	27.04	10.10c	30.66
T_4: 60% RFD	4.95bc	43.90	6.06ab	41.26	11.01bc	42.43
T_5: 70% RFD	5.32abc	54.65	6.75ab	57.34	12.07abc	56.14
T_6: 80% RFD	5.63abc	63.66	7.05a	64.34	12.68abc	64.04
T_7: 90% RFD	5.90ab	71.51	7.38a	72.03	13.28ab	71.80
T_8: 120%RFD	6.35a	84.59	7.81a	82.05	14.16a	83.18
SE (±)	0.20		0.27		0.46	

Figure (s) in a column having common letter(s) do not differ significantly at 5% level of significance and the figures which are not lettered are non significant at 5% level of significance; RFD = 100 kg N ha^{-1} + 15 kg P ha^{-1} + 50 kg K ha^{-1} + 15 kg S ha^{-1} + 1.5 kg Zn ha^{-1}.

Table-4: Nitrogen, P, K and S content in grain and straw of BRRI Dhan28 as influenced by reduced rates of fertilizer

Treatment	%N		%P		%K		%S	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
T_1: Control	1.120b	0.520b	0.217	0.119	0.225c	0.348c	0.122c	0.084c
T_2 : RFD	1.411a	0.632ab	0.236	0.126	0.286ab	0.502a	0.141ab	0.121a
T_3: 50% RFD	1.125b	0.545b	0.224	0.125	0.237c	0.351bc	0.125bc	0.102b
T_4 : 60% RFD	1.175b	0.560ab	0.228	0.129	0.245c	0.365bc	0.129abc	0.110ab
T_5 : 70% RFD	1.185b	0.568ab	0.234	0.128	0.270b	0.419ab	0.136abc	0.113a
T_6 : 80% RFD	1.275ab	0.587ab	0.237	0.124	0.275ab	0.429ab	0.135abc	0.118a
T_7 : 90% RFD	1.378a	0.603ab	0.235	0.128	0.281ab	0.491a	0.141ab	0.117a
T_8: 120% RFD	1.419a	0.698a	0.239	0.130	0.297a	0.522a	0.145a	0.123a
SE (±)	0.028	0.014	0.002	0.002	0.005	0.018	0.002	0.003

Figure (s) in a column having common letter(s) do not differ significantly at 5% level of significance and the figures which are not lettered are non significant at 5% level of significance; RFD = 100 kg N ha^{-1} + 15 kg P ha^{-1} + 50 kg K ha^{-1} + 15 kg S ha^{-1} + 1.5 kg Zn ha^{-1}.

Potassium content

Potassium content in both grain and straw were significantly affected by the different treatments (Table 4). Potassium content varied from 0.225 to 0.297% in grain and 0.348 to 0.522% in straw. The highest K content (0.297%) in grain and 0.522% in straw was found in the treatment T_8 which was statistically similar to those recorded in the treatments T_2, T_6 and T_7 with values 0.286, 0.275 and 0.281% K respectively. The lowest K content was recorded in the treatment T_l) which was statistically similar to the treatment T_3. It is also observed that K content in straw was higher than that of grains in all the treatments. It indicates that 120% RFD had pronounced effect on K content in both grain and straw but (30%) reduction of the fertilizers from the recommended fertilizer dose affect non-significantly in K content. The results were also in agreement with the findings of Sachdev *et al.* (1983). Sarfaraz *et al.* (2002) found that K concentrations in grain and straw significantly increased with the application of NPK + S fertilizers compared to the control.

Sulphur content

Table 4 indicated that sulphur content in both grain and the straw of BRRI dhan28 was significantly influenced by the different treatments. Sulphur content in grain ranged from 0.122 to 0.145% and in straw varied from 0.084 to 0.123%. The maximum S content (0.145%) in grain was found in the treatment T_8 which was statistically similar to those recorded in the treatments $T_{2,}$ T_5, T_6 and T_7 with values 0.141, 0.136, 0.135 and 0.141% S respectively. The highest S content (0.123%) in straw was recorded in the treatment T_8. The lowest S content in grain (0.145 %) and in straw (0.084%) was noted in the treatment T_l. It indicates that 120% RFD had pronounced effect on S content in both grain and straw but the smaller reduction of the fertilizers from the recommended fertilizer dose did not affect significantly in S content.

Nutrient uptake by BRRI dhan28

Nitrogen uptake

Nitrogen uptake by grain and straw of BRRI dhan28 was significantly affected due to different treatments (Figure 1). The N uptake varied from 38.76 to 91.91 kg ha^{-1} by grain and from 25.50 to 54.50 kg ha^{-1} in straw. The highest N uptake (91.91kg ha^{-1}) by grain and (54.50 kg ha^{-1}) by straw was recorded in the treatment T_8 (120% RFD) which was statistically similar to those recorded in the treatments T_2: RFD, T_6: 80% RFD and T_7: 90%. The lowest N uptake (38.76 kg ha^{-1}) by grain and (25.50 kg ha^{-1}) by straw was obtained in the treatment T_1 (control) which was statistically similar to the treatment T_3: 50% RFD. The total N uptake due to different treatments ranged from 64.26 to 146.40 kg ha^{-1}. The highest total N uptake (146.40 kg ha^{-1}) was recorded in the treatment T_8 which was statistically similar to those recorded in the treatments T_2, T_6 and T_7 with the values of 133.38, 113.28 and 126.88%, respectively. The lowest total N uptake (64.26 kg ha^{-1}) was noted in the treatment T_1 which was statistically similar to the treatment T_3. Sarfaraz *et al.* (2002) found that N uptake in grain and straw significantly increased with the application of NPK + S fertilizers compared to the control.

Phosphorus uptake

The phosphorus uptake in both grain and straw of BRRI dhan28 was significantly influenced due to various treatments used (Figure 1). The ranges of P uptake in grain were 8.14 to 15.36 kg ha^{-1} and in straw were 5.53 to 10.39 kg ha^{-1}. The maximum P uptake (15.36 kg ha^{-1}) by grain was recorded in the treatment T_8 which was statistically similar to those recorded in the treatments T_2, T_5, T_6 and T_7 with values 14.25, 12.49, 13.34 and 13.86%, respectively. The highest P uptake (10.39 kg ha^{-1}) in straw was recorded in the treatment T_8. The minimum P uptake (8.14 kg ha^{-1}) by grain (5.53 kg ha^{-1}) by straw was found in the treatment T_1 which was statistically similar to the treatment T_3. The total P uptake by BRRI dhan28 varied from 13.68 kg ha^{-1} in T_1 to 25.75 kg ha^{-1} in T_8. The highest total P uptake (25.75 kg ha^{-1}) was recorded in the treatment T_8 which was statistically similar to those recorded in the treatments T_2, T_5, T_6 and T_7 with values 23.74, 21.13, 22.11 and 23.40% P uptake respectively. Sarfaraz *et al.* (2002) found that P uptake in grain and straw significantly increased with the application of NPK + S fertilizers compared to the control.

Potassium uptake

Potassium uptake was significantly influenced by various treatments (Figure 1). The K uptake by grain varied from 7.73 to 18.83 kg ha^{-1} and in straw ranged from 12.11 to 40.78 kg ha^{-1} (Figure 1). The highest K uptake (18.83kg ha^{-1}) by grain and (40.78 kg ha^{-1}) by straw was noted in the treatment T_8 (120% RFD) which was statistically similar to those recorded in the treatments T_2 T_6 and T_7. The lowest K uptake (7.73 kg ha^{-1}) by grain a (12.11 kg ha^{-1}) by straw was obtained in the treatment T_1. It was observed that K uptake by rice straw was much higher than that of K uptake by rice grain. The highest total K uptake (59.62 kg ha^{-1}) was observed in the treatment T_8, T_6 and T_7 and the lowest (19.83 kg ha^{-1}) was obtained in the treatment T_1 which was statistically similar to that recorded in the treatment T_3. Sarfaraz *et al.* (2002) found that K uptake in grain and straw significantly increased with the application of NPK + S fertilizers compared to the control.

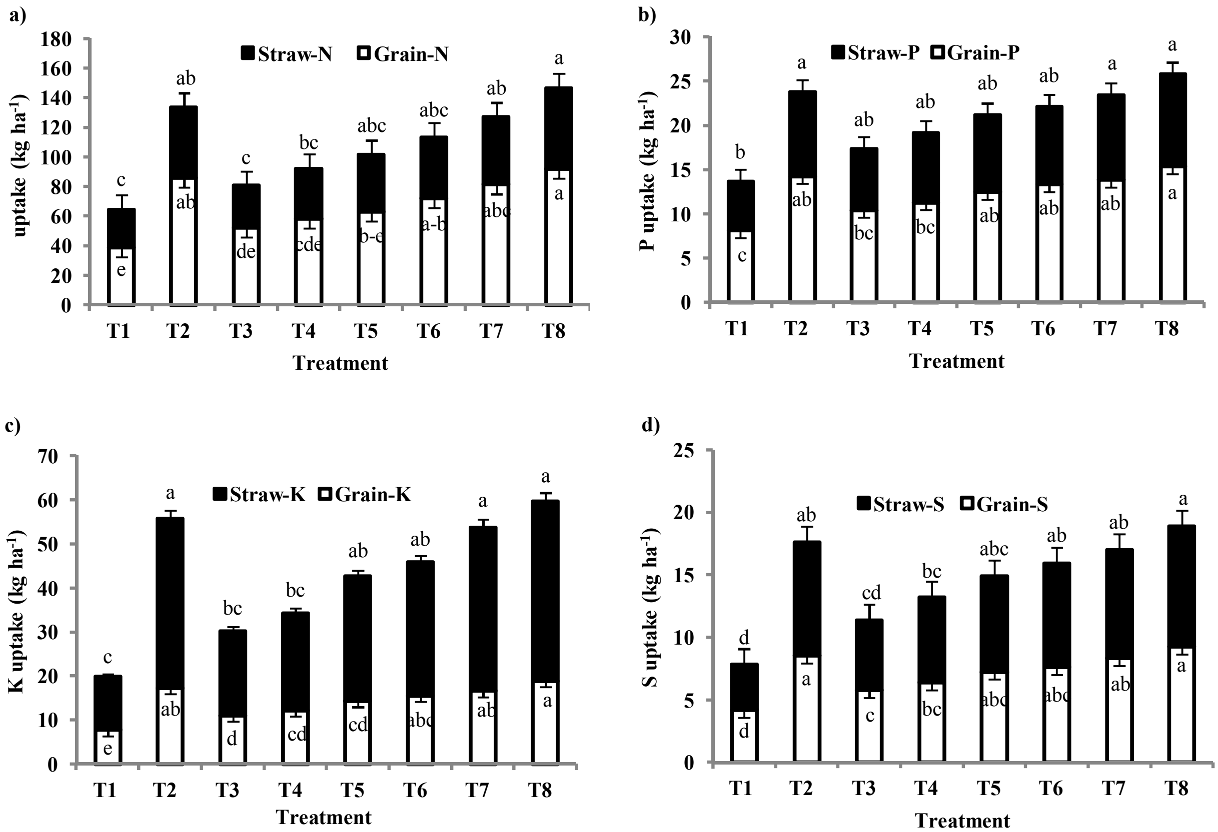

Figure-1: Effects of reduced rates of fertilizer on a) N, b) P, c) K and d) S uptake by BRRI dhan28

Sulphur uptake

The S uptake in grain varied from 4.20 to 9.25 kg ha^{-1} and in straw ranged from 3.61 to 9.63 kg ha^{-1} (Figure 1). The highest S uptake by grain (9.25 kg ha^{-1}) and by straw (9.63kg ha^{-1}) was obtained in the treatment T_8 which was statistically similar to those recorded in the treatments T_2, T_5, T_6 and T_7. The lowest S uptake (4.20 kg ha^{-1}) by grain and (3.61 kg ha^{-1}) by straw was recorded in the treatment T_1 (control). In case of total S uptake, S uptake ranged from 7.81 to 18.88 kg ha^{-1}. The maximum total S uptake (18.88 kg ha^{-1}) was recorded in the treatment T_8 and the lowest total S uptake (7.81 kg ha^{-1}) was observed in the treatment T_1 (control). Sarker (1995) reported that concentration of S in grain and straw and its corresponding uptake increased with increasing rates of sulphur.

4. Conclusion

The maximum grain yield (6.35 t ha^{-1}) was obtained from 120% recommended fertilizer dose. The treatment of 120% RFD also resulted the maximum N, P, K and S contents and uptake as well as total uptake both in grain and straw. Application of at best 30% reduction of all the fertilizers from recommended fertilizer dose affect non-significantly in yield, nutrient content and uptake. In the experiment 120% of recommended fertilizer dose performed better than other treatments and 30% reduction of all the fertilizers from recommended fertilizer dose did not differ significantly compared to RFD. So, it may be inferred that if anyone want to increase the crop yield then he may practice 120% RFD but this variety may be cultivated at BAU farm soil by 30% reduction of all the fertilizers from recommended fertilizer dose without affecting yield.

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