



Effect of Phosphorus And Sulphur on Yield of Brri Dhan 57

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Abstract : An experiment was conducted during the period from July, 2011 to December, 2011 to on the performance study of rice regarding to growth, yield and yield contributing characters of rice BRRI dhan 57 under the AEZ-28. The two factors experiment consists with four levels of Phosphorus (P) viz. P₀: without Phosphorus (control), P₁: 20 kg ha⁻¹, P₂: 40 kg ha⁻¹ and P₃: 60 kg ha⁻¹ and four levels of Sulphur viz. S₀: without Sulphur (control), S₁: 10 kg ha⁻¹, S₂: 20 kg ha⁻¹ and S₃: 30 kg ha⁻¹. The result obtained from the study, it was found that all the traits were statistically significant due to Phosphorus whereas 40 kg P ha⁻¹ recorded the tallest plant (109.70 cm) at harvest and maximum tillers hill⁻¹ (17.58) at 85 DAT. Phosphorus @ 40 kg ha⁻¹ also recorded the greater results on effective tillers hill⁻¹ (13.67), panicle length (22.04 cm), filled grains panicle⁻¹ (138.60), 1000-grain weight (30.75 g), weight of grain, straw and biological yield 5.12, 8.39 and 13.51 t ha⁻¹, respectively and harvest index (37.85%) at harvest while without phosphorus obtained the lower results on the above. In case of Sulphur, all the traits were significant except plant height at 55, 85 DAT and at harvest, filled grains panicle⁻¹ and 1000-grain weight whereas 20 kg S ha⁻¹ obtained the tallest plant (109.40 cm) at harvest and maximum tillers hill⁻¹ (16.28) at 85 DAT. The maximum effective tillers hill⁻¹ (12.12), longest panicle (21.35), higher weight of grain, straw and biological yield 4.75, 8.08 and 12.82 t ha⁻¹, respectively and harvest index (36.90%) were taken in 20 kg S ha⁻¹ at harvest. It was also observed the minimum non effective tillers hill⁻¹ (2.83) and unfilled grains panicle⁻¹ (12.04) whereas all the Sulphur levels were produced statistically similar filled grains panicle⁻¹ and 1000-grain weight at harvest due to non significant variation. The present findings obviously recommended that 40 kg P ha⁻¹ or 20 kg S ha⁻¹ singly or their interactions would be optimum level for getting the higher production of BRRI dhan 57.

Key Words: BARI Dhan 57, Phosphorus, Sulphur, Yield

Introduction

Rice (*Oryza sativa* L.) is the dominant staple food for many countries in Asia and Pacific, South and North America as well as Africa (Mobasser *et al.*, 2007). It is also the most important food crop and a major food grain for more than a third of the world population (Zhao *et al.*, 2011). In Bangladesh, during the year 2010–2011, rice covered an area of 28.5 thousand acres with a production of 33.5 million M tons while the average yield of rice in Bangladesh is around 1.2 thousand tons per acres whereas the transplant aman rice covers the largest area of 13951 acres (48.97%) with a production of 12792 thousand M tons rice grain (38.14%) and the average yield is about 971 kg ha⁻¹ in Bangladesh in 2010–11 (BBS, 2012). Fertilizer is very important input for intensive rice production. The profitability of rice production systems depends on yield and input quantities. So the appropriate fertilizer input that is not only for getting high grain yield but also for attaining maximum profertility (Khuang *et al.*, 2008). Phosphorus fertilizer is a major essential plant nutrient and key input for increasing crop yield (Dastan *et al.*, 2012; Alinajoati Sisie and Mirshekari, 2011; Alam *et al.*, 2009). It was also important for the phosphorus accumulation in cultivated soils is a concern for non-point environmental pollution and for efficiency of phosphorus resources because of excessive phosphorus input (Li *et al.*, 2010). Phosphorus deficit is a most important restrictive factor in plant growth and recognition of mechanisms that increase plant phosphorus use

efficiency is important (Alinajoati Sisie & Mirshekari, 2011). So, the appropriate fertilizer input that is not only for getting high grain yield but also for attaining maximum profitability (Khuang *et al.*, 2008). Sulphur (S) is another essential macronutrient and it plays a vital role in the plant system and its deficiency in Bangladesh was first detected in rice at BRRI farm at Joydebpur in 1976. In recent years, S deficiency has been receiving much attention as a major limiting factor for wetland rice. For rice cultivation, next to nitrogen, S application is very important. So, in fertilizer schedule, it is commonly included (Islam *et al.*, 2009). So, it is needed to pay more attention to conduct more research with appropriate dose of S fertilizer in rice. From the above aspects, it is appeared that the cultivation or rice is the most effective means to increase the yield per unit area by applying the proper doses of P and S fertilizers. Considering above points, the present study was undertaken to achieve the following objectives: to find out the appropriate doses of P and S regarding to proper growth and higher production of BRRI dhan 57, to select the most advantageous treatment combination of P and S fertilizers concerning to growth and yield of BRRI dhan 57.

Materials and Methods

This chapter describes the experimental aspects of the study. The experiment was conducted at the research farm of the period from July 2011 to December 2011 (Kharif II) to judgment out the most appropriate singly or combined doses of Phosphorus (P) and Sulphur (S) on the aspect of better growth, higher production and yield and superior quality of grain and straw of studied rice cultivar cv. BRRI dhan 57. The experimental area is situated in the sub-tropical climatic zone and characterized by heavy rainfall during the months of April to September (Kharif Season) and scanty rainfall during the rest period of the year (Biswas, 1987).

Plant materials (variety)

The seeds of BRRI dhan 57 were used as planting materials which was collected from the Bangladesh Rice Research Institute (BRRI), Joydebpur, Gazipur-1701.

Experimental design and layout:

The experiment consisted of four doses of Phosphorus (P) and four doses of Sulphur (S) and was laid out a two factors split-plot (Phosphorus in the main plot and Sulphur in the sub-plot) in Randomized Complete Block Design (RCBD) with three replications. The size of plot was 4.0×3.0 m (12 m^2) where block to block and plot to plot distance was 0.75 and 0.5 m, respectively. Row to row and plant to plant distance were also 20 and 20 cm, respectively, in each plot. So, the total plots were $4 \times 4 \times 3$ (P $4 \times$ S $4 \times$ Replication 3).

Crop Management,

Seed collection, seed sprouting, preparation of seedling nursery, seed sowing, land preparation for transplanting, fertilizer application, uprooting of seedlings, transplanting of seedlings, intercultural operations, weeding, sampling and data collection, harvest and post harvest operations were done.

Parameters studied

1000 grain weight (g), grain yield (t ha^{-1}), straw yield (t ha^{-1}), biological yield (t ha^{-1}), harvest index (%) were studied.

Statistical analyses

Data recorded for yield and yield contributing characters and seed quality characters were compiled and tabulated in proper form for statistical analyses. Analysis of variance was done with the help of MSTAT-C computer package programme developed by Russel (1986). The mean

differences among the treatments were evaluated with DMRT test (Gomez and Gomez, 1984).

Results and Discussion

The present research work was to investigate the effect of Phosphorus and Sulphur on the performance of growth and yield of rice cv. BRRI dhan 57 under the Agro-ecological zone of "The Modhupur Tract", AEZ-28. The results on yield and yield attributing characters of BRRI dhan 57 have been presented in Tables 1 to 4.

Interaction effect of Phosphorus and Sulphur

The data on unfilled grains panicle⁻¹ showed significant difference among the interaction effect between Phosphorus and Sulphur (Table 1). The unfilled grains panicle⁻¹ varied from 7.87 to 16.27 due to interaction effect of Phosphorus and Sulphur fertilizers. The minimum number of unfilled grains panicle⁻¹ (16.27) was found in interaction of 0 kg P ha⁻¹ and 10 kg S ha⁻¹ which was followed by the interaction effects of both 0 kg P and S ha⁻¹ (15.85) and 0 kg P ha⁻¹ and 30 kg S ha⁻¹ (16.02) whereas interaction effect of 0 kg P ha⁻¹ and 10 kg S ha⁻¹ and 0 kg P ha⁻¹ and 30 kg S ha⁻¹ were statistically identical to produced unfilled grains panicle⁻¹. On the other hand, interaction effect between 40 kg P ha⁻¹ and 20 kg S ha⁻¹ obtained the minimum number of unfilled grains panicle⁻¹ (7.87) which was statistically differed from other interactions (Table 1).

Effect of phosphorus

Application of phosphorus as soil and foliar application at various levels showed significant variation in respect of harvest index in the present study (Table 2). From the Table 2, it was appeared that the highest harvest index (37.85%) was found in 40 kg P ha⁻¹ in case of the higher yield of grain and straw as well as maximum biological yield were found under this treatment. Similarly, the control treatment observed the lowest harvest index (34.82%) due to its lowest yield of grain and straw as well as minimum biological yield were achieved in this treatment. Another treatment also showed significant effect while harvest index of 36.03 and 35.47% were found in 20 and 60 kg P ha⁻¹, respectively (Table 2). These results revealed that the variation in harvest index was found due the variation in phosphorus levels. These were similar to Yosef (2013b) whereas they found that the maximum harvest index was (47.92) observed for 90 kg ha⁻¹ phosphorus fertilizer and minimum of that was (47.79) obtained for (control) 0 kg ha⁻¹ phosphorus fertilizer.

Table 1. Interaction effect between Phosphorus and Sulphur on number of effective and non effective tillers hill⁻¹, length of panicle and number of filled and unfilled grains panicle⁻¹ production at harvest

Phosphorus levels (kg ha ⁻¹)	Sulphur levels (kg ha ⁻¹)	Number of effective tillers hill ⁻¹	Number of non effective tillers hill ⁻¹	Length of panicle (cm)	Number of filled grains panicle ⁻¹	Number of unfilled grains panicle ⁻¹
0	0	7.167 o	3.833 c	18.70 k	108.8 h	15.85 ab
	10	7.833 m	3.900 b	19.49 i	109.4 h	16.27 a
	20	9.633 h	3.700 d	19.93 g	112.8 g	15.58 b
	30	7.267 n	3.967 a	19.18 j	108.9 h	16.02 ab
20	0	9.100 j	3.300 h	20.02 fg	117.6 e	13.55 fg
	10	9.800 g	3.333 h	20.48 e	118.2 e	13.97 def
	20	11.97 e	2.767 j	21.42 c	130.2 c	11.62 h
	30	9.200 i	3.433 g	20.17 f	117.8 e	13.72 ef
40	0	12.80 d	2.367 l	21.43 c	137.4 b	8.450 i
	10	13.43 b	2.467 k	21.89 b	138.0 b	8.867 i
	20	15.53 a	1.967 m	23.26 a	141.4 a	7.867 j
	30	12.90 c	2.500 k	21.58 c	137.6 b	8.617 i
60	0	8.400 l	3.500 f	19.70 h	114.5 fg	14.15 cde
	10	9.133 j	3.500 f	20.16 f	115.0 f	14.57 c
	20	11.33 f	2.900 i	20.78 d	123.6 d	13.08 g
	30	8.500 k	3.633 e	19.85 gh	114.6 fg	14.32 cd
Level of significance		*	**	**	**	**
LSD _(0.05)		0.05329	0.05329	0.1685	1.975	0.4971
SX value		0.01826	0.01826	0.05774	0.6765	0.1703
CV (%)		1.03	1.14	0.5	0.96	2.29

Figures followed by same letter(s) are statistically similar as per DMRT at 5%

LSD= Least significant difference; CV= Co-efficient of variation; *= Significant at 5% level of probability

Table 2. Main effect Phosphorus on 1000-grain weight, yield characters and HI at harvest

Phosphorus levels (kg ha ⁻¹)	Grain yield (t ha ⁻¹)	Straw yield (t ha ⁻¹)	Biological yield (t ha ⁻¹)	Harvest index (%)	
0	3.768 d	7.047 d	10.81 d	34.82 c	
20	4.247 b	7.523 b	11.77 b	36.03 b	
40	5.116 a	8.393 a	13.51 a	37.85 a	
60	4.016 c	7.294 c	11.31 c	35.47 bc	
Level of significance		**	**	**	**
LSD _(0.05)		0.5958	0.07993	0.2638	0.7164
SX value		0.2041	0.02739	0.09037	0.2455
CV (%)		1.65	1.26	2.65	2.36

Figures followed by same letter(s) are statistically similar as per DMRT at 5%

LSD= Least significant difference; CV= Co-efficient of variation; *= Significant at 5% level of probability

Effect of Sulphur

Harvest index represent comparative yield performance between grain and straw yield. It was also indicate the percent grain yield on the basis of biological yield. The data on harvest index was significantly influenced by the Sulphur application in this study. Sulphur @ 20 kg ha⁻¹ recorded the highest harvest index (36.90%). The lowest harvest index (35.45%) was observed in without Sulphur

which was statistically similar to 30 kg S ha⁻¹ (35.71%). However, 10 kg S ha⁻¹ obtained harvest index of 36.11% which was statistically close to both higher and lower harvest index in this study (Table 3). These results revealed that harvest index differed significantly due to the significant differences of the studied Sulphur application and also the variation of grain and straw yield as well as biological yield.

Table 3. Main effect Sulphur on 1000-grain weight, yield characters and HI at harvest

Sulphur levels (kg ha ⁻¹)	Grain yield (t ha ⁻¹)	Straw yield (t ha ⁻¹)	Biological yield (t ha ⁻¹)	Harvest index (%)
0	3.958 c	7.177 c	11.14 b	35.45 b
10	4.375 b	7.713 b	12.09 ab	36.11 ab
20	4.745 a	8.075 a	12.82 a	36.90 a
30	4.068 c	7.293 c	11.36 b	35.71 b
Level of significance	**	**	*	*
LSD _(0.05)	0.1842	0.279	1.369	0.8405
SX value	0.05323	0.08062	0.3955	0.2429
CV (%)	1.65	1.26	2.65	2.36

Figures followed by same letter(s) are statistically similar as per DMRT at 5%

LSD= Least significant difference; CV= Co-efficient of variation; *= Significant at 5% level of probability

Interaction effect of Phosphorus and Sulphur

Analysis of variance data regarding to harvest index was significantly influenced by the interaction effect of the studied Phosphorus and Sulphur fertilizers (Table 4). Table 4 indicated that the harvest index varied from 34.24 to 38.59% where the interaction treatment of 40 kg P ha⁻¹ and 20 kg S ha⁻¹ recorded the highest harvest index (38.59%) which was closely followed by the interactions effect of 40 kg P ha⁻¹ × 10 kg S ha⁻¹ (37.83%), 20 kg P ha⁻¹ × 20 kg S ha⁻¹ (37.18%), 40

kg P ha⁻¹ × 0 kg S ha⁻¹ (37.39%) and 40 kg P ha⁻¹ × 30 kg S ha⁻¹ (37.58%) whereas 20 kg P ha⁻¹ × 20 kg S ha⁻¹, 40 kg P ha⁻¹ × 0 kg S ha⁻¹ and 40 kg P ha⁻¹ × 30 kg S ha⁻¹ were statistically identical. In contrast, the lowest harvest index (34.24%) was recorded in both control fertilizers which was also closely followed by the maximum interactions of both fertilizers among the rest interaction effects. The variation in harvest index was found due to the variation yield of grain, straw and biological yield and also the variation in fertilizer levels.

Table 4. Interaction effect between Phosphorus and Sulphur on 1000-grain weight, yield characters and HI at harvest

P levels (kg ha ⁻¹)	S levels (kg ha ⁻¹)	Thousand grain weight (g)	Grain yield (t ha ⁻¹)	Straw yield (t ha ⁻¹)	Biological yield (t ha ⁻¹)	Harvest index (%)
0	0	25.88 i	3.497 k	6.717 l	10.21 l	34.24 f
	10	26.42 ghi	3.914 gh	7.252 gh	11.17 ghij	35.05 def
	20	27.08 fgh	4.053 f	7.387 fg	11.44 fgh	35.44 def
	30	26.05 hi	3.607 jk	6.833 kl	10.44 kl	34.55 ef
20	0	27.69 f	3.877 gh	7.093 hi	10.97 hijk	35.33 def
	10	28.23 ef	4.293 e	7.631 e	11.92 ef	36.00 cde
	20	29.48 cd	4.833 c	8.160 c	12.99 c	37.18 abc
	30	27.86 ef	3.987 fg	7.210 h	11.20 ghi	35.60 def
40	0	30.22 bc	4.767 c	7.983 d	12.76 cd	37.39 abc
	10	30.76 ab	5.185 b	8.523 b	13.71 b	37.83 ab
	20	31.63 a	5.637 a	8.967 a	14.60 a	38.59 a
	30	30.39 bc	4.877 c	8.100 cd	12.98 c	37.58 abc
60	0	27.16 fgh	3.693 ij	6.913 jk	10.60 jkl	34.83 def
	10	27.69 f	4.109 f	7.447 f	11.56 fg	35.56 def
	20	28.90 de	4.457 d	7.787 e	12.24 de	36.39 bcd
	30	27.32 fg	3.803 hi	7.030 ij	10.83 jk	35.11 def
Level of sig.	*	**	*	*	*	
LSD _(0.05)	1.025	0.1192	0.1599	0.5275	1.433	
SX value	0.3512	0.04082	0.05477	0.1807	0.4909	
CV (%)	2.15	1.65	1.26	2.65	2.36	

Figures followed by same letter(s) are statistically similar as per DMRT at 5%

LSD= Least significant difference; CV= Co-efficient of variation; *= Significant at 5% level of probability

The results of the present study were obtained on various characteristics of yield and yield attributing traits of BRRI dhan 57 whereas all the studied characters were statistically significant at 5% level due to phosphorus application where 40 kg P ha⁻¹ showed superior performance on them.

The result of plant height and tillers hill⁻¹ were significantly increase with the advancement of study period while tillers production significantly decreased at harvest due to its mortality for maturity. Maximum tillers hill⁻¹ was also observed in 20 kg S ha⁻¹ and minimum tillers hill⁻¹ in control

S at 85 DAT while it decreased at harvest. On the other hand, the maximum effective tillers hill⁻¹, longest panicle, higher weight of grain, straw and biological yield and harvest index were taken in 20 kg S ha⁻¹ at harvest. Similarly, control S recorded the minimum effective tillers hill⁻¹, shortest panicle, minimum yield of grain, straw and biological and lowest HI whereas statistically similar lower effective tillers hill⁻¹, shortest panicle, lowest yield of grain, straw and biological and lowest HI

were also found in higher doses of S (30 kg S ha⁻¹). However, 20 kg S ha⁻¹ observed the minimum non effective tillers hill⁻¹ and unfilled grains panicle⁻¹ but maximum non effective tillers hill⁻¹ and unfilled grains panicle⁻¹ were taken in 30 kg S ha⁻¹ and 10 kg S ha⁻¹, respectively while all the S levels including control were produced statistically similar filled grains panicle⁻¹ and 1000-grain weight at harvest due to non significant variation.

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