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EFFECT OF NKS NUTRIENTS ON THE GROWTH AND YIELD OF BRRI dhan29

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Abstract

A field experiment was conducted at the field of Regional station of Bangladesh Rice Research Institute (BRRI), Habigonj, during the period from December 2012 to May 2013 to evaluate the effect of NKS nutrients on the growth and yield of BRRI dhan29. The experiment was laid out in a randomized complete block design with three replications. The experiment was consisted with six treatments viz., $N_{85}P_{35}K_{50}S_9$, $P_{38}K_{50}S_9$(-N), $N_{85}P_{38}S_9$(-K), $N_{85}P_{38}K_{50}$(-S), $P_{38}S_9$(-NK) and $N_0P_0K_0S_0$ (control). Results of the experiment indicated that N, K and S nutrients alone or in combination with each other significantly affected the growth, yield and yield contributing characters of BRRI dhan29. Grain and straw yields were obtained highest in $N_{85}P_{38}K_{50}S_9$ (8.40 and 10.10 t ha^{-1}) and the lowest in $P_{38}S_9$ (-NK) (5.50 and 6.50 t ha^{-1}) which was supported by the data obtained in different growth and yield contributing characters, respectively.

Keywords: Rice, NKS nutrients, growth, yield

Introduction

Bangladesh is mainly an agricultural country. Most of the economic activities of the country directly or indirectly depend on agriculture. The soil and climate of Bangladesh are favorable for rice production. In the country, 77.69 % of total cultivated land (about 11.15 million hectares) is under rice cultivation with a production of 33.53 million metric tons with the average yield of 3.78 t ha-1 (BBS, 2012). The rapid growth of population is one of the major challenges of Bangladesh. The population growth rate is about 1.34 %, which is adding about two million additional new mouths every year and they need to be fed. Therefore, it is an urgent need of the time to increase the production of rice through increasing the yield. Rice as well as other crops depends on the supply of available nutrients (chemical fertilizer). Most of the rice soils of Bangladesh are deficient in N, P, K and S. The response of modern rice varieties to nitrogen application has always been observed remarkably high. When one or more essential nutrient elements are limited in the soil, plant growth slows down and the grain yield decreases. BRRI Regional station, Habigonj, has been conducted long term missing elements studies to see the effect of different essential nutrients and optimize the fertilizer application to get high yield. Soils of BRRI regional station Habigonj are low to very low in nitrogen and phosphorus and sulfur status is low to optimum. The present study was undertaken to observe the effect of N, K and S on the growth and yield of BRRI dhan29 through different nutrients combination treatments.

Materials and Methods

The experiment was conducted during the period from December 2012 to May 2013 at the field of Bangladesh Rice Research Institute (BRRI) Regional station, Habigonj. The soil belongs to Baniachong soil series under the Agroecological zone of Old Meghna Estuarine Floodplain (AEZ 19). The soil of the experimental area is acidic (pH 5.1) and clay texture. There were six treatments in the experiment viz. $N_{85}P_{38}K_{50}S_9$, $P_{38}K_{50}S_9$ (-N), $N_{85}P_{38}S_9$ (-K), $N_{85}P_{38}K_{50}$ (-S), $P_{38}S_9$ (-NK) and $N_0P_0K_0S_0$ (control). The experiment was laid out in a randomized complete block design (RCBD) with three replications. NPKS nutrients were applied from the sources of urea, triple superphosphate, muriate of potash and gypsum, respectively. BRRI dhan29, a high yielding variety of rice was used as a test crop. Seeds were sown on the seedbed on December 02, 2012 for raising nursery seedlings. Transplanting was done at 7 January 2013 using 35 days old seedlings. Two hand weedings were done for each plot, first weeding was done at 25 days after transplanting followed by second weeding at 40 days after first weeding. Standing water was maintained 2-3 cm in the field throughout the growing period. Recommended cultural practices were followed for better crop establishment. Data were recorded 25 days interval at 40, 65, 90 days after transplanting and at harvest. Data were collected for measuring growth characters and yield and yield parameters. The rice plants were

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harvested just above ground level at full maturity when 80 % of the grains become golden yellow in color. The crop was harvested from 5 m^2 area at the center of each plot avoiding the border lines to avoid border effect. The statistical analysis of the data was done using computer package program (MSTAT) and the means were separated using DMRT test.

Results and Discussion

Plant height (cm)

The plant height of BRRI dhan29 was significantly affected by different treatments (Table 1). The tallest plant (108.4 cm) was recorded due to the treatment $N_{85}P_{38}K_{50}S_9$ which was statistically similar to the treatment $N_{85}P_{38}K_{50}$ (-S) with the corresponding height of 106.67 cm. The shortest plant (89.8 cm) was recorded in the treatment $N_0P_0K_0S_0$. Idris and Matin (1990) stated that plant height increased up to application of 120 kg N ha^{-1} compared to the control. The present finding is agreed with their statement.

Table 1. Effect of NKS nutrients on the plant height and number of tillers $hill^{-1}$ after transplanting of BRRI dhan29

Treatment	Plant height (cm)	Tillers $hill^{-1}$ (no.) at different days after transplanting (DAT)			
		40 DAT	65 DAT	90 DAT	At Harvest
$N_{85}P_{38}K_{50}S_9$	108.40 a	12.67 a	15.33 a	15.67 a	13.00 a
$P_{38}K_{50}S_9$ (-N)	92.70 c	8.66 b	12.67 ab	13.00 ab	10.33 bc
$N_{85}P_{38}S_9$ (-K)	100.40 b	12.00 a	15.00 a	15.33 a	12.00 ab
$N_{85}P_{38}K_{50}$ (-S)	106.67 ab	11.33 ab	14.33 a	15.67 a	12.00 ab
$P_{38}S_9$ (-NK)	91.67 c	9.00 b	12.00 bc	12.67 b	10.00 bc
$N_0P_0K_0S_0$ (control)	89.80 c	8.33 b	11.33 c	12.67 b	9.33 c
CV (%)	21.36	11.33	10.5	6.07	12.58
Level of significance	0.01	0.01	0.01	0.01	0.01

Figure(s) in a column having similar letter(s) do not differ significantly at 0.01% probability where as different letter(s) indicate significantly different.

Number of tillers $hill^{-1}$

Data pertaining to the number of tillers $hill^{-1}$ is given in Table 1. The number of tillers $hill^{-1}$ showed progressive increase up to 90 DAT and thereafter it decreased till crop maturity. At 40 DAT, the highest number of tillers $hill^{-1}$ (12.67) of BRRI dhan29 was recorded in $N_{85}P_{38}K_{50}S_9$ which showed statistically similar with the treatments $N_{85}P_{50}S_9$ (-K) and $N_{85}P_{38}K_{50}$ (-S). The lowest number of tillers $hill^{-1}$ (8.33) was obtained in $N_0P_0K_0S_0$ (control) which was similar to the treatments $P_{38}K_{50}S_9$ (-N) and $P_{38}S_9$ (-NK) having the values of 8.66 and 9.0, respectively. Similar trend remained at 65 DAT, 90 DAT and at harvest. Chowdhury *et al*. (1995) observed that application of different levels of N significantly affected tillering in rice. They reported that number of tillers $hill^{-1}$ increased significantly with increasing N level.

Dry matter accumulation

Dry matter accumulation of different plant parts of BRRI dhan29 are presented in Tables 2, 3 and 4. The dry matter production of the leaf sheath, leaf, stem and panicle increased with the age of rice plants. NKS nutrients alone or in combination significantly influenced the dry weight of leaf sheath, leaf, stem and panicle $hill^{-1}$ of BRRI dhan29 at different days after transplanting.

Leaf sheath dry weight

At booting stage, the highest dry weight (7.16 g) of leaf sheath $hill^{-1}$ was recorded in treatment $N_{85}P_{38}K_{50}S_9$ which was statistically identical with the treatments $N_{85}P_{38}S_9$ (-K) and $N_{85}P_{38}K_{50}$(-S). Treatment $P_{38}S_9$ (-NK) produced the lowest dry weight (5.9 g). Similar trend remained at flowering and maturity stage.

Leaf dry weight

All the fertilizer treatments increased the dry matter weight over control at booting stage, flowering stage and maturity stage. At booting stage, the highest weight of dry matter (4.17 g) in leaf was recorded in the treatment $N_{85}P_{38}K_{50}S_9$ which was statistically similar to the all other treatments except $N_0P_0K_0S_0$ and the lowest weight of dry

matter (2.08 g) of leaf hill^{-1} was recorded in the treatment $N_0P_0K_0S_0$. Similar trend remained at flowering stage and maturity stage.

Table 2. Effect of NKS nutrients on dry matter weight of leaf sheath and leaf at different days after transplanting of BRRI dhan29

Treatments	Dry matter weight of leaf sheath hill^{-1} (g) at different stage			Dry weight of leaf hill^{-1} (g) at different stage after transplanting		
	Booting stage	Flowering stage	Maturity stage	Booting stage	Flowering stage	Maturity stage
$N_{85}P_{38}K_{50}S_9$	7.16 a	8.17 ab	13.83 a	4.17 a	6.40 a	6.23 a
$P_{38}K_{50}S_9$ (-N)	6.00 bc	6.90 bc	11.70 ab	3.67 a	4.63 b	4.58 b
$N_{85}P_{38}S_9$ (-K)	6.73 a	7.83 ab	13.03 ab	4.07 a	6.33 a	6.03 a
$N_{85}P_{38}K_{50}$ (-S)	7.06 a	8.43 a	12.83 ab	3.97 a	6.23 a	6.32 a
$P_{38}S_9$ (-NK)	5.90 c	6.83 bc	10.50 bc	3.76 a	4.67 b	4.42 b
$N_0P_0K_0S_0$ (control)	6.07 b	5.33 c	9.50 c	2.08 b	3.06 c	4.10 b
CV (%)	7.17	10.68	12.58	16.34	12.40	10.25
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01

Figure(s) in a column having similar letter(s) do not differ significantly at 0.01% probability where as different letter(s) indicate significantly different.

Table 3. Effect of NKS nutrients on dry weight of stem and panicle of the BRRI dhan29 at different days after transplanting.

Treatments	Dry weight of stem hill^{-1} (g) at different stage after transplanting			Dry weight of panicle hill^{-1} (g) at different stage after transplanting	
	Booting stage	Flowering stage	Maturity stage	Flowering stage	Maturity stage
$N_{85}P_{38}K_{50}S_9$	6.85 a	8.83 a	7.83 a	19.02 a	33.33 a
$P_{38}K_{50}S_9$ (-N)	5.37 c	5.50 b	4.92 bc	13.00 c	23.67 c
$N_{85}P_{38}S_9$ (-K)	6.83 a	9.27 a	7.73 a	13.93 b	27.33 b
$N_{85}P_{38}K_{50}$ (-S)	6.17 b	8.60 a	8.75 a	17.80 a	30.50 a
$P_{38}S_9$ (-NK)	5.33 c	6.06 b	5.95 bc	13.28 b	23.33 c
$N_0P_0K_0S_0$ (control)	3.50 d	5.10 c	4.67 c	14.00 b	22.50 c
CV (%)	4.38	10.35	10.35	10.56	6.09
Level of significance	0.01	0.01	0.01	0.01	0.01

Figure(s) in a column having similar letter(s) do not differ significantly at 0.01% probability where as different letter(s) indicate significantly different.

Table 4. Effect of NKS nutrients on total dry matter weight of BRRI dhan29 at different days after transplanting.

Treatments	Total dry matter weight hill^{-1} (g) at different stage after transplanting		
	Booting stage	Flowering stage	Maturity stage
$N_{85}P_{38}K_{50}S_9$	18.87 a	42.75 a	69.67 a
$P_{38}K_{50}S_9$ (-N)	14.83 b	30.80 b	52.86 c
$N_{85}P_{38}S_9$ (-K)	16.97 a	39.36 a	61.86 b
$N_{85}P_{38}K_{50}$ (-S)	17.83 a	41.07 a	66.10 a
$P_{38}S_9$ (-NK)	15.00 b	30.87 b	52.77 c
$N_0P_0K_0S_0$ (control)	12.65 c	27.50 c	49.20 c
CV (%)	5.38	11.35	13.45
Level of significance	0.01	0.01	0.01

Figure(s) in a column having similar letter(s) do not differ significantly at 0.01% probability where as different letter(s) indicate significantly different.

Table 5. Effect of NKS nutrients on the yield and yield contributing characters of BRRI dhan29

Treatment	No. of effective tillers hill^{-1}	No. of non-effective tiller hill^{-1}	Panicle length (cm)	No. of grains panicle^{-1}	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
$N_{85}P_{38}K_{50}S_9$	12.66 a	0.55 a	27.00 a	141.20 a	23.77 a	8.40 a	10.1 a
$P_{38}K_{50}S_9$ (-N)	9.00 c	0.46 a	21.17 bc	119.35 c	22.00 b	5.76 b	6.90 b
$N_{85}P_{38}S_9$ (-K)	11.66 ab	0.43 a	22.00 bc	129.50 b	23.57 ab	8.33 a	9.57 a
$N_{85}P_{38}K_{50}$ (-S)	12.00 ab	0.69 a	23.83 b	130.00 b	23.73 a	8.36 a	10.00 a
$P_{38}S_9$ (-NK)	10.00 bc	0.40 a	21.33 bc	120.30 c	22.43 ab	5.50 b	6.50 b
$N_0P_0K_0S_0$(control)	10.66 b	0.65 a	19.83 c	119.00 c	22.83 ab	5.83 b	6.67 b
CV (%)	6.70	18.67	5.93	12.43	4.6	10.64	6.7
Level of Significance	0.01	NS	0.01	0.01	0.01	0.01	0.01

Figure(s) in a column having similar letter(s) do not differ significantly at 0.01% probability whereas different letter(s) indicate significantly different.

Stem dry weight

The stem dry weights at booting stage ranged from 3.50 to 6.85 g. The highest weight (6.85 g) of stem hill^{-1} was recorded in the treatment $N_{85}P_{38}K_{50}S_9$ which was statistically similar to $N_{85}P_{38}S_9$ (-K) having the value 6.83. The lowest weight of dry matter (3.50 g) of stem hill^{-1} was recorded in the treatment $N_0P_0K_0S_0$. Almost similar trend remained at flowering stage and maturity stage.

Panicle dry weight

Dry weight of panicles was significantly affected due to different treatments at flowering stage and maturity stage. At flowering stage, the highest dry weight (19.02 g) of panicles hill^{-1} was recorded in the treatment $N_{85}P_{38}K_{50}S_9$ and the lowest dry weight (13.00 g) of panicle hill^{-1} was recorded in the treatment $P_{38}K_{50}S_9$ (-N). Similar trend remained at maturity stage.

Total dry matter weight

At booting stage, the highest weight (18.87 g) of total dry matter hill^{-1} was recorded in the treatment $N_{85}P_{38}K_{50}S_9$ and which was statistically similar to treatments $N_{85}P_{38}K_{50}$ (-S) and $N_{85}P_{38}S_9$ (-K). The lowest weight (12.65 g) of total dry matter hill^{-1} was recorded in the treatment $N_0P_0K_0S_0$. At flowering and maturity stage, the highest total dry matter weight was recorded in the treatment $N_{85}P_{38}K_{50}S_9$ and lowest in the treatment $N_0P_0K_0S_0$.

Combination of NPKS fertilizers increased dry matter in leaf, leaf sheath, stem and panicle than other treatments. These results are in agreement with Chandrashekarappa (1985) who reported that application of 100 kg N, 50 kg P_2O_5 and 50 kg K_2O ha^{-1} increased dry matter production of rice.

Number of effective tillers and non-effective tillers hill^{-1}

There was a significant effect due to N, K and S nutrients alone or in combination on the production of effective tillers hill^{-1} of BRRI dhan29 Table 5. The highest number (12.66) was noted in treatment $N_{85}P_{38}K_{50}S_9$. The lowest number of effective tillers hill^{-1} (9.0) was counted in the treatment $P_{85}K_{38}S_9$(-N). Dixit and Singh (1979) and Jashim *et al*. (1984) reported that the increased N application increased the tiller number plant^{-1}. NKS nutrients alone or in combination did not affect the number of non-effective tillers hill^{-1} of BRRI dhan29 (Table 5).

Panicle length (cm)

Data pertaining to panicle length is presented in Table 5. NKS nutrients alone or in combination significantly influenced the panicle length of BRRI dhan29. The longest panicle (27.00 cm) was recorded in the treatment $N_{85}P_{38}K_{50}S_9$. The shortest panicle (19.83 cm) was noted in the treatment $N_0P_0K_0S_0$. These results are in agreement

with Azad *et al.* (1995) who found that the panicle length of rice increased significantly with increasing levels of nitrogen from 0 to 75 kg ha^{-1}.

Number of grain $panicle^{-1}$

Number of grains $panicle^{-1}$ of BRRI dhan29 was significantly affected due to different treatments (Table 5). Application of fertilizers increased the number of grains $panicle^{-1}$ over control. Number of grains $panicle^{-1}$ was the highest (141.20) in the treatment $N_{85}P_{38}K_{50}S_9$. The lowest number of grains $panicle^{-1}$ (119.0) was recorded in the treatment $N_0P_0K_0S_0$. These results are in agreement with Hussain and Sharma (1991) who reported that the highest grains $panicle^{-1}$ was produced by 80 kg N ha^{-1} and the lowest in control.

1000-grain weight

NKS nutrients alone or in combination significantly influenced the 1000-grain weight of BRRI dhan29 (Table 5). The highest 1000-grain weight (23.77 g) was recorded in the treatment $N_{85}P_{38}K_{50}S_9$ and the lowest weight (22.00 g) was noted in the treatment $P_{38}K_{50}S_9$ (-N). Mondal *et al.* (1987) reported that increasing rates of N from 40-160 kg ha^{-1} increased 1000-grain weight.

Grain and straw yield (t ha^{-1})

There was a significant effect on the yield of BRRI dhan29 due to NKS nutrients alone or in combinations (Table 5). The highest grain yield (8.4 t ha^{-1}) was noted in the treatment $N_{85}P_{38}K_{50}S_9$ which was statistically identical to the treatments $N_{85}P_{38}S_9$ (-K) and $N_{85}P_{38}K_{50}$ (-S).

The lowest grain yield (5.5 t ha^{-1}) was obtained in the treatment $P_{38}S_9$ (-NK) and which was similar to the treatments $P_{38}K_{50}S_9$ (-N), $P_{38}S_9$ (-NK) and $N_0P_0K_0S_0$ (control). Like grain yield, the treatment $N_{85}P_{38}K_{50}S_9$ also produced the highest straw yield (10.1 t ha^{-1}). The highest straw yield was obtained in the treatment $N_{85}P_{38}K_{50}S_9$ and the lowest straw yield (6.5 t ha^{-1}) was obtained in the treatment $P_{38}S_9$ (-NK). Krishnan *et al.* (1994) revealed a linear response of increasing N levels on grain yield and it continued to increase up to 240 kg N ha^{-1}.

Results of the study indicated that application of balanced fertilizer @ $N_{85}P_{38}K_{50}$ and S_9 was optimum for obtaining higher grain yield for the rice variety BRRI dhan29 for Habigonj soil. However, further experimentation is needed to confirm the results as one year's trial is not enough for final recommendation.

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