ISSN 0258-7122
Bangladesh J. Agril. Res. 37(1): 179-184, March 2012 **Short Communication**

RESPONSE OF RICE *(Oryza sativa* L) TO SPLIT APPLICATION OF POTASSIUM IN OLD BRAHMAPUTRA FLOOD PLAIN SOIL

M. S. UDDIN[1], M. J. ABEDIN MIAN[2] AND M. A. SALEQUE[4]

Keywords: Potassium, soil, yield.

A field study was carried out with BRRI dhan 29 at the Soil Science field laboratory, BAU, Mymensingh during the period from February to June 2007 to evaluate the effects of split application on the yield, nutrient content, and nutrient uptake of BRRI dhan 29. There were 9 treatments, such as control (NPSZn+K_{50}), (NPSZn+$K_{25\ (FLP)}$ +$K_{25\ (SA)}$), (NPSZn+$K_{75\ (FLP)}$), (NPSZn+$K_{37.5\ (FLP)}$ +$K_{37.5\ (SA)}$), (NPSZn+$K_{100(FLP)}$), (NPSZn+$K_{50(FLP)}$+$K_{50(SA)}$), (NPSZn+$K_{125(FLP)}$), and (NPSZn+$K_{62.5\ (FLP)}$ +$K_{62.5\ (SA)}$). The grain and straw yield was highly favoured by split application of potassium. The highest grain yield was 6.72 t/ha and straw yield was 6.83 t/ha in treatment (NPSZn+$K_{37.5\ (FLP)}$ +$K_{37.5\ (SA)}$).

Rice is the leading cereal crop in the world. It is the staple food crop in Bangladesh, which alone contributes about 95% of the food grain production of the country (Julfiquar *et al*., 1998). The yield of rice is quite low in Bangladesh compared to other leading rice producing countries like Japan, China, Korea, and USA where the yield is 6.22, 6.06, 7.00, and 6.35 t/ha, respectively (FAO, 1999). The reasons for low yield are sterility of rice grains. Among the various causes of sterility, lack of proper doses of potassium and mode of its application at proper stage of crop growth are important. If the sterility problem can be overcome, the rice yield will definitely be increased to a considerable extent. Use of potassium, especially at the later stage of crop growth is believed to reduce the sterility percentage in rice, which favours the yield of this crop. Time of application of potassium is also an important aspect for rice production.

Significantly higher yield of rice have been reported due to split application rather than single application (Das *et al*., 1975 and Singh and Singh, 1978). Split application of K gave 20% more yield than that of full dose applied at transplanting (Ismunadji, 1976). Fertilizer K should be applied in rice crops in such a way that minimum is lost through leaching and maximum is utilized for plant growth and grain production. In order to increase the use efficiency and reduce loss of K, it should be applied in split at various phases of plant growth and development. A little information is available on the effectiveness of split application of K fertilizer in rice cultivation in Bangladesh. The present study was conducted to see the effects of split application of K on the yield of BRRI dhan 29 rice.

---

[1]Assistant Professor, Department of Agriculture, Govt. V.M. College, Saturia, Manikgonj, [2]Professor, Dept. of Soil Science, Bangladesh Agricultural University (BAU), Mymensingh, [3]Principal Scientific Officer, Soil Science Division, Bangladesh Rice Research Institute (BRRI), Gazipur, Bangladesh.

The experiment was carried out in rice growing medium high land belonging to non-calcareous dark-grey flood plain soils under AEZ-9 (Old Brahmaputra Flood Plain soil). The soil was silt loam. The status of pH, organic matter, total N, P, K, and S of the soil were 6.74, 2.63%, 0.14%, 15.7 ppm, 0.12 cmol/kg and 22.7ppm, respectively. BRRI dhan 29 was used as test crop in this trial. There were 9 treatments, such as T_1 (control), T_2(NPSZn+K_{50}), T_3(NPSZn+$K_{25\ (FLP)}$ +$K_{25\ (SA)}$), T_4(NPSZn+$K_{75\ (FLP)}$), T_5(NPSZn+$K_{37.5\ (FLP)}$ +$K_{37.5\ (SA)}$), T_6(NPSZn+$K_{100\ (FLP)}$, T_7(NPSZn+$K_{50\ (FLP)}$ +$K_{50\ (SA)}$, T_8(NPSZn+$K_{125\ (FLP)}$), and T_9(NPSZn+$K_{62.5\ (FLP)}$ +$K_{62.5\ (SA)}$). Potassium was applied by two splits; the first split during land preparation and remaining at 40 days of transplanting i.e., at active vegetative stage for the treatments T_3, T_5, T_7, and T_9. But full dose of K was under treatments T_2, T_4, T_6, and T_8 were applied at a time at the time of land preparation. One hundred and twenty kg, 14, 8, and 1 kg/ha N (Urea), P (TSP), S (Gypsum), and Zn (ZnO), respectively, were applied as basal dose on soil test basis. The experiment was designed in RCBD with 3 replications. The grain and straw yield were recorded. The nutrient content in grain and straw was determined. Nutrient uptake was also calculated. All intercultural operations were done as when and necessary.

Grain yield of BRRI dhan 29 was significantly increased over control due to different doses of potassium. The grain yield due to various treatments varied from 4.15 to 6.72 t/ha (Table 1). The yield gradually increased upto 75 kg K/ha and then a declining trend was observed by addition @ 100 and 125 kg K/ha. All the treatments except control were identical although variation was noted between treatments. Split application was always found better than single application. The highest grain yield of 6.72 t/ha was found in T_5 (NPSZn+$K_{37.5\ (FLP)}$ +$K_{37.5\ (SA)}$) and lowest grain yield (4.15 t/ha) was obtained in T_1 (control) treatment.

Calculating the percentage of grain yield increase over the control, it was observed that application of 50 kg K/ha in T_2 treatment produced 35% additional yield. Moreover, application of 50 kg K/ha in two equal splits (T_3) produced another 3% more yield over single application. Application of 75 kg K/ha (T_4) produced 5.88 t/ha, which was 42% increase over control and 4-7% increase over 50 kg K/ha (T_2 and T_3). A jump increase of 62% over control (T_1) and 20% over T_4 was obtained when 75 kg K/ha was applied in two splits (37.5 kg at final land preparation and 37.5 kg/ha at 40 day after transplantation. Ghosh *et al*. (1995) reported that grain yield was increased by split application of K as compared with 100% basal application. Similar results were also reported by Kanti *et al*. (2000).

Table 1. Effects of potassium on grain and straw yield of Boro rice (BRRI dhan 29).

Treatments	Grain		Straw	
	Yield (t/ha)	Increase over control (%)	Yield (t/ha)	Increase over control (%)
T_1 (control)	4.15c	-	4.35c	-
T_2(NPSZn+K_{50})	5.61b	35	5.81b	34
T_3(NPSZn+$K_{25\,(FLP)}$ +$K_{25\,(SA)}$)	5.74b	38	5.93b	36
T_4(NPSZn+$K_{75\,(FLP)}$)	5.88b	42	5.94b	37
T_5(NPSZn+$K_{37.5\,(FLP)}$ +$K_{37.5\,(SA)}$)	6.72a	62	6.83a	57
T_6(NPSZn+$K_{100\,(FLP)}$	5.67b	37	5.82b	34
T_7(NPSZn+$K_{50\,(FLP)}$ +$K_{50\,(SA)}$	5.74b	38	5.98b	38
T_8(NPSZn+$K_{125\,(FLP)}$)	5.63b	36	5.90b	36
T_9(NPSZn+$K_{62.5\,(FLP)}$ +$K_{62.5\,(SA)}$)	5.76b	39	5.99b	38
LSD	0.68	-	0.43	-

The straw yield ranged from 4.35 to 6.83 t/ha (Table 1). The variation in straw yield due to single and split application of potassium were statistically significant. Like grain yield, the treatment T_5 (splited $K_{37.5+37.5}$ kg/ha) also produced the highest straw yield (6.83 t/ha).This yield was 57% higher over control which produced the lowest straw yield (4.35 t/ha). The maximum yield of T_5 treatment was due to the production of maximum number of effective tillers/hill. Similar result was observed by Singh *et al.* (2002).

Nitrogen concentration varied from 1.13 to 1.47% in rice grain of BRRI dhan 29 (Table 2). The highest N concentration 1.47% in grain was found in T_3 and the lowest 1.13% was in T_1 (control). Nitrogen concentration of straw varied from 0.53 to 0.82% (Table 2). The highest and the lowest N concentration in straw were noted in treatments T_9 and T_1, respectively. Split application of K increase the N concentration both in grain and straw because of their synergistic relationship.

Phosphorous concentration in grain varied from 0.25 to 0.39% (Table 2). The highest P concentration 0.36% was recorded in T_7, which was statistically identical to T_9. Treatment T_1 showed the lowest concentration when compared with other treatments. Phosphorous concentration in straw varied from 0.11 to 0.16% (Table 2).The highest P concentration was noted with T_3 and the lowest value (0.15%) was found in T_1 treatment. Similar result was also observed by Dahdoh (1997). Phosphorus concentration decreased in K splitted plot compared to K unsplitted plots because of synergistic relationship between P and K on yield. As a result, yield increased but concentration decreased. The result is supported by the findings of Anonymous (1998).

Table 2. Nutrient contents in grain and straw of Boro rice (BRRI dhan 29)

Treatments	Nutrients concentration (%)							
	Grain				Straw			
	N	P	K	S	N	P	K	S
T_1 (control)	1.13	0.25	0.25	0.085	0.53	0.15	1.15	0.057
T_2(NPSZn+K_{50})	1.30	0.28	0.28	0.087	0.62	0.15	1.45	0.062
T_3(NPSZn+$K_{25\,(FLP)}$ +$K_{25\,(SA)}$)	1.47	0.23	0.33	0.097	0.72	0.16	1.53	0.066
T_4(NPSZn+$K_{75\,(FLP)}$)	1.18	0.23	0.36	0.093	0.74	0.11	1.46	0.065
T_5(NPSZn+$K_{37.5\,(FLP)}$ +$K_{37.5\,(SA)}$)	1.30	0.29	0.47	0.130	0.78	0.12	1.84	0.087
T_6(NPSZn+$K_{100\,(FLP)}$	1.17	0.30	0.40	0.106	0.70	0.15	1.68	0.084
T_7(NPSZn+$K_{50\,(FLP)}$ +$K_{50\,(SA)}$	1.27	0.36	0.43	0.108	0.84	0.13	1.74	0.067
T_8(NPSZn+$K_{125\,(FLP)}$)	1.29	0.30	0.44	0.112	0.78	0.16	1.76	0.060
T_9(NPSZn+$K_{62.5\,(FLP)}$ +$K_{62.5\,(SA)}$)	1.37	0.36	0.46	0.118	0.82	0.16	1.82	0.100

The potassium content in grain varied from 0.25 to 0.47% in grain and 1.15 to 1.84% in straw (Table 2). The highest and the lowest K concentration were obtained in T_5 and T_1 treatments, respectively. Similar result was also observed by Dahdoh (1997). Potassium concentration was higher both in grain and straw in K splitted plots than unsplitted plots. Soil solution K was higher in K splitted plot than unsplitted plots. As a consequence, K concentration was higher in K splitted plots compared to K unsplitted plots.

Data on sulphur due to potassium application have been shown in the Table 2. The concentration of S in grain varied from 0.085 to 0.130% (Table 2). The highest S concentration 0.130% was noted from T_5 and the treatment T_1 exhibited the lowest value compared to other treatments. Its concentration in straw varied from 0.057 in T_1 to 0.100% in T_9 treatment (Table 2). Split application of K increase the S concentration both in grain and straw because of their synergistic relationship.

Results on N, P, K, and S uptake by Boro rice have been presented in Table 3. The uptake of these nutrients increased over control due to different treatment combinations but the rate of increase varied considerably between the treatments as well as nutrients. In general, split application of K showed better performance than single application. The variation in N, P, K, and S uptake was mostly influenced by the concentration and yields. The uptake of nutrients was the highest in T_5 (split application of 75.0 kg K/ha) and the lowest in T_1 (control).

Table 3. Nutrients uptake by Boro rice (BRRI dhan 29).

Treatments	Nutrients uptake (kg/ha)			
	N	P	K	S
T_1 (control)	71.52	17.17	60.52	6.11
T_2(NPSZn+K_{50})	116.01	24.75	99.96	8.53
T_3(NPSZn+$K_{25\ (FLP)}$ +$K_{25\ (SA)}$)	128.44	22.86	105.84	9.61
T_4(NPSZn+$K_{75\ (FLP)}$)	114.41	20.14	108.12	9.91
T_5(NPSZn+$K_{37.5\ (FLP)}$ +$K_{37.5\ (SA)}$)	132.91	29.75	155.56	13.27
T_6(NPSZn+$K_{100\ (FLP)}$	108.64	26.39	120.45	10.66
T_7(NPSZn+$K_{50\ (FLP)}$ +$K_{50\ (SA)}$	119.15	29.16	128.73	11.33
T_8(NPSZn+$K_{125\ (FLP)}$)	124.61	27.03	128.61	11.12
T_9(NPSZn+$K_{62.5\ (FLP)}$ +$K_{62.5\ (SA)}$)	128.14	30.92	135.51	12.79

The overall results of this study showed that BRRI dhan 29 positively responded to potassium application. The treatment T_5 (NPSZn+$K_{37.5\ (FLP)}$ +$K_{37.5\ (SA)}$) showed more beneficial effect on higher yield on BRRI dhan 29. Split application of K (½ at final land preparation and the rest ½ at 40th day after transplantation) showed better performance than single application.

References

Dahdoh, M.S.A. 1997. Mutual effect of some nutrients on wheat plants. *Egyptian J. Soil Sci.* **37**(4):484-497.

Das, K.C., A. Mishra and J. Pandey.1975. Split application of potassium for rice. *Indian J. Potassium Res.* **1**(1):13-16.

FAO (Food and Agriculture Organization). 1999. Production Year Book. Vol.52. Food and Agriculture Organization of the United Nations. Rome, Italy. p.64.

Ghosh, S.K., S. Pal and A.K. Mukhapadhay.1995. Split application of potassium to maximize its efficiency on yield of high yielding rice. *Indian J. Agron.* **39**(4):259-264.

Ismunadji, M. 1976. In "Fertilizer Use and Plant Health" proc. 12 the Colloq. Inster. Potash Inst., Berne. p. 47-60.

Julfiquar, A.W., M.M. Haque, A.K.G.M. Enamul Haque and M.A. Rashid. 1998. Current status of hybrid rice research and future program in Bangladesh. A country report presented in the workshop on use and development of hybrid rice in Bangladesh, May, 18-19. BARC. Dhaka, Bangladesh.

Kanti, P., R.P.S. Chauhan and K. Prasad. 2000. Rice response to rate and time of application of potassium in an upland ecosystem. *J. Potassium Res.* **16** (1-4):32-34.

Singh, D. and R. Singh. 1978. Potassium status of soils and response of rice to applied potassium. *J. Potassium Res.* **15**(1-4):83-87.

Singh, J., H.L. Sharma, C.N. Singh and J. Singh 2002. Effect of levels of phases of potassium application on growth and yield of rice and wheat. *J. Potassium Res.* **16**(1/4):35-40.

Anonymous. 1998. Potassium interactions with other nutrients. *Better Crops* **82**(3): 12-13.