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Influence of Split Application of Potassium on Yield and Yield Contributing Characters of rice cultivars- BR11 and Nizersail

S.N. Mahfuza[1], M.N. Islam[2], Shamima Aktar[3], M. R Amin[4*] and M. A. Islam[5]

[1]*Agronomy Division;* [2]*Seed Division;* [3]*Pulse Research Centre;* [4]*Post-harvest Technology Section, HRC,* [5]*Farm Division, Bangladesh Agricultural Research Institute, Gazipur-1701, Bangladesh*
**Corresponding author: E-mail*: *mni81@yahoo.com*

Abstract

Influence of split application of K on the sterility of BR11 and Nizersail was investigated in a field experiment conducted at the Bangladesh Agricultural University farm, Mymensingh during T. Aman season of 2003. The two rice varieties BR11 and Nizersail were grown with potassium applied at 70 kg and 60 kg K/ha, respectively. Split application of K showed similar effect of increasing trend in all the crop characters with the increase of the split applications from 1 to 3. Four splits were inferior to all. Three split of potassium showed superiority over 2, 1and 4 splits in almost all the crop characters, where the performance of Nizersail seemed to be better except in respect of sterile spikelets, grain yield and harvest index, where the superiority of BR11 was observed.

***Keywords*:** Split application of potassium, yield contributing characters.

1. Introduction

Rice (*Oryza sativa* L.) is the leading cereal crop in the world in terms of area under cultivation and the number of people depending on the crop. It is the staple food for nearly half of the world's population. In Bangladesh, yield of rice is quite low (2.76 t ha^{-1}), compared to that of other leading rice producing countries like Japan, China, Korea and USA, where the yields are 6.22, 6.06, 7.00 and 6.35 t ha^{-1}, respectively (FAO, 1999).

The reasons for low yield of rice are manifold. Potassium application increases the grain yield, available K content of soil and its uptake by rice crop (Roy and Mathur, 1989). Significant yield increase of 12% to potassium in rice was observed by Doberman et al. (1995). Time of application of K is an important aspect for rice production. Significantly higher yields of rice to split application rather than single application of potassium have been reported by many workers (Das *et al*., 1975; Singh and Singh, 1978). Split application of K gave 20% more yield than that given by full dose applied at transplanting (Ismunadji, 1976). Tiwari *et al*.(1992) have cited several references showing distinct benefit of applying potassium in split doses. In Bangladesh, K is traditionally applied in rice field just before transplanting or at final land preparation. The present research was therefore, undertaken to study the effect of split application of potassium on the yield and yield contributing characters of BR11 and Nizersail grown in T. Aman season.

2. Materials and Methods

A field experiment was conducted in T. Aman season of 2003 at Bangladesh Agricultural

University farm, Mymensingh with one HYV rice variety BR11 (V_1) and a local improved variety Nizersail (V_2). BR11 were grown with 70 kg ha^{-1} and Nizersail with 60 kg ha^{-1}K along with a basal dose of fertilizer at the rate of 20 kg P, 10 kg S and 3.5 kg Zn ha^{-1} applied uniformly in all the plots and thoroughly incorporated into the soil at the time of final land preparation. Potassium in the form of MP was applied in the experimental plots in four splits such as: 1st split (S_1) at final land preparation, 2nd split (S_2) at final land preparation and 30 days after transplanting (DAT), 3rd split (S_3) at final land preparation and 30 and 60 DAT and 4th split (S_4) at final land preparation and 30, 60 and 90 DAT. Nitrogen (N) was applied at the rate of 80 and 45 kg ha^{-1} for BR11 and Nizersail, respectively in the form of urea in three equal splits- immediately after seedling establishment, at maximum tillering and at 7-8 days before panicle initiation stage. The land area was medium high belonging to the Sonatala Soil Series of Non Calcareous Dark Grey Flood plain soil type under the Old Brahmaputra Floodplain of Agro-Ecological Zone No. 9. The pH value of soil was 6.5. The experiment was laid out in a split plot design with three replications. The test varieties were accommodated in the main plots and the split application of K in the sub plots randomly. Unit plot size was 6 m^2. Thirty day old seedlings were transplanted on 7 August 2003 maintaining three seedlings in each hill. Seedlings were transplanted in rows 25 cm apart and the distance between the hills was 15 cm. Intercultural operations and plant protection measures were taken as and when necessary. Five hills from each plot were selected randomly prior to harvest for recording data on crop characters and the yield was estimated from the harvest of whole plot. Harvesting of BR11 was done on 23 November and Nizershail on 15 December, 2003. The recorded data were analyzed statistically.

3. Results and Discussion

3.1. Effect of variety

Nizersail showed superiority to BR11 in respect of plant height, total number of tillers $hill^{-1}$ and bearing tillers $hill^{-1}$ (Table 1). On the other hand, BR11 produced significantly higher number of grains $panicle^{-1}$ (89.08) and sterile spikelets $panicle^{-1}$ (25.74), thousand grain weight (23.56 g) and grain yield (2.79 tha^{-1}) than Nizersail (2.10 tha^{-1}) (Table 1). Production of taller plants, larger number of tillers $hill^{-1}$ favoured Nizersail to produce significantly larger amount of straw and biological yields than BR11. But the number of grains $panicle^{-1}$ and 1000-grain weight favoured to produce significantly higher grain yield in BR11. Varietal difference in respect of plant height, total tillers $hill^{-1}$, grains $panicle^{-1}$ and 1000- grain weight was reported by Shamsuddin *et al*. (1988). Similar results was also cited by Sterns *et al.* (2001), where they observed the greatest yields occurred with the rice varieties Baldo when potash was applied in split applications at mid season at the Missouri Rice Research Farm.

3.2. Effect of split application of potassium

Effect of split application of potassium on bearing and non bearing tillers $hill^{-1}$, grains and sterile spikelets $panicle^{-1}$ and grain, straw and biological yields is shown in Table 2. Potassium had a pronounced effect on both the rice varieties BR11 and Nizersail producing the maximum number of tillers $hill^{-1}$, grains $panicle^{-1}$, grain, straw and biological yields. An increased application of potassium from 0 to 66 kg ha^{-1} increased the number of tiller m^{-2} (Thakur *et al.*, 1993) and increased grain yield over the untreated control (Mahapatra and Carew, 1980). Though the highest number of sterile spikelets $panicle^{-1}$ was observed in three split application (S_3) of potassium, grain yield was also significantly highest (3.94 tha^{-1}) in this treatment. The maximum plant height was observed in three-split application (S_3) of potassium (at final land preparation and 30 and 60 DAT) which was followed by two-split (S_2), one-split (S_1) and four-split (S_4).

Table 1. Effect of variety on the crop characters of BR11 and Nizersail

Variety	Plant height (cm)	Total tillers hill^{-1} (no.)	Bearing tillers hill^{-1}(no.)	Non Bearing tillers hill^{-1} (no.)	Grains panicle^{-1} (no.)	Sterile spikelets panicle^{-1} (no.)	Thousand grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
BR11	111.92b	12.08b	9.92b*	2.19b	89.08a	25.74a	23.56a	2.79a	3.58b	6.33b	43.35a
Nazersail	148.64a	15.73a	12.89a	2.79a	86.14b	9.50b	17.32b	2.10b	4.90a	7.01a	29.38b
CV (%)	4.12	4.17	5.27	5.78	4.51	5.63	8.79	6.53	4.49	4.56	4.22

Means followed by common letter are not significantly different at 5% level by DMRT

Table 2. Effect of split application of potassium on the crop characters of BR11 and Nizersail

Split application of K	Plant height (cm)	Total tillers hill^{-1} (no.)	Bearing tillers hill^{-1}(no.)	Non bearing tillers hill^{-1} (no.)	Grains panicle^{-1} (no.)	Sterile spikelets panicle^{-1} (no.)	Thousand grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
S_1	126.83c	12.53c	9.99c	2.01c	85.92c	16.84c	20.42	2.27c	3.91c	6.20c	36.98b
S_2	131.90b	14.65b	12.23b	2.73b	89.15b	18.76b	20.48	2.65b	4.52b	7.17b	37.24b
S_3	140.34a	18.65a	14.86a	3.81a	92.21a	20.45a	20.48	3.49a	5.76a	9.15a	38.27a
S_4	122.15d	9.79d	8.55d	1.41d	83.17d	14.42d	20.48	1.36d	2.79d	4.16d	32.97c
CV (%)	4.12	4.17	5.27	5.78	4.51	5.63	8.79	6.53	4.49	4.56	4.22

Means followed by common letter are not significantly different at 5% level by DMRT

Table 3. Interaction effect of variety and split application on the crop characters of BR11 and Nizersail

Interaction of variety and split application of K (V×S)	Plant height (cm)	Total tillers hill^{-1} (no.)	Bearing tillers hill^{-1}(no.)	Non bearing tillers hill^{-1} (no.)	Grains panicle^{-1} (no.)	Sterile spikelets panicle^{-1} (no.)	Thousand grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
V_1S_1	108.03	10.19g	8.97e	1.72e	86.93	24.91c	23.60	2.56c	3.37f	5.94f	43.01b
V_1S_2	113.33	12.66e	10.77d	2.37d	90.47	27.57b	23.51	3.11b	3.80e	6.91d	45.00a
V_1S_3	122.48	17.46b	11.82c	3.59b	94.56	29.87a	23.54	3.80a	4.73c	8.31b	44.55a
V_1S_4	104.03	8.02h	8.11f	1.07f	84.36	20.59d	23.58	1.69f	2.45h	4.14g	40.83c
V_2S_1	145.63	14.86d	11.02d	2.30d	84.90	8.76g	17.25	1.99e	4.46d	6.46e	30.94d
V_2S_2	150.46	16.64c	13.68b	3.08c	87.83	9.95f	17.45	2.19d	5.24b	7.43c	29.47e
V_2S_3	158.20	19.84a	17.88a	4.04a	89.86	11.04e	17.43	3.19b	6.79a	9.99a	31.99d
V_2S_4	140.26	11.57e	9.00e	1.75e	81.98	8.26g	17.38	1.04g	3.13g	4.18g	25.11f
CV (%)	4.12	4.17	5.27	5.78	4.51	5.63	8.79	6.53	4.49	4.56	4.22

Means followed by common letter are not significantly different at 5% level by DMRT

The same trend exhibited in respect of all the other crop characters due to split application of K. Ghosh *et al*. (1982), Ram and Prasad (1985), Narang *et al*. (1997), and Nannabatcha *et al.* (1985) also reported the similar results with the three split applications of potassium.

3.3. Interaction effect of variety and split application of potassium

3.3.1. Total number of tillers hill^{-1}

The maximum number of tiller hill^{-1} was produced in Nizersail when combined with three-split applications of potassium (V_2S_3) and it was the lowest in BR11 with four splits of potassium (V_1S_4) (Table 3). In general, three-split application of potassium showed superiority in case of both the varieties followed by two and one split, with significant difference in each treatment combination.

3.3.2. Number of bearing tillers hill^{-1}

Nizersail with three splits of potassium (V_2S_3) produced the maximum number of bearing tillers hill^{-1} and it was in succession with significant difference by Nizersail with two splits (V_2S_2), BR11 with three splits (V_1S_3) and Nizersail with basal application (V_2S_1) (Table 3). In general, Nizersail produced larger number of bearing tillers than those of BR11 with the corresponding splits of potassium.

3.3.3. Number of non bearing tillers hill^{-1}

The trend of interaction effect between variety and split application of potassium on the number of non bearing tillers hill^{-1} was found to have adverse effect in case of Nizersail with all the split application of K in the order of three, two, one and four splits over BR11 with the corresponding splits of potassium (Table 3).

3.3.4. Number of sterile spikelets panicle^{-1}

The maximum number of sterile spikelets panicle^{-1} was observed in BR11 with three-split applications of K followed by 2, 1 and 4 splits each with significant difference (Table 3). The same trend was also found in Nizersail with the corresponding splits of K indicating the superiority of Nizersail for this character.

3.3.5. Grain yield

The interaction effect of variety and split application of potassium was found to be more favourable on the grain yield in BR11 than in Nizersail (Table 3). In both the varieties, grain yields increased with the every increase of the number of split upto three and the 4th split was inferior to all. Annadurai *et al.* (2000) reported that split application of K on rice either in two splits (basal and panicle initiation) or three splits (basal, active tilering and panicle initiation) produced higher grain yield. Devasenapathy (1997) reported that application of potassium in split doses enhanced the enzymatic activities, probably caused higher mobilization of nutrients in soil and plant and translocation of photosynthetics in plant system, which ultimately resulted in higher grain and straw yields.

3.3.6. Straw yield

Straw yield also showed almost the same trend as did grain yield due to the interaction effect of variety and split application of K (Table 3). BR11 showed superiority over Nizershail with the every increase in splits of K from 1 to 3.

3.3.7. Biological yield

The maximum biological yield was obtained from Nizersail with three splits of K due to the interaction effect of variety and split application of K (Table 3). The highest yield was followed in succession each with significant difference by Nizersail with three splits, BR11 with three splits, Nizersail with two splits, BR11 with two splits, Nizersail with one split, BR11 with one split, Nizersail by four splits and BR11 by four splits.

3.3.8. Harvest index

The interaction effect of variety and split application of K on harvest index showed a bit different trend than those of grain, straw, and biological yields (Table 3). Here, BR11 with two-split application produced the highest harvest index followed by 3, 1 and 4 splits with same variety. On the other hand, Nizersail was to some extent inferior to BR11 with split application of K where three splits produced the highest harvest index followed by 1, 2 and 4 splits with Nizersail.

4. Conclusions

Potassium application significantly increased the number of spikelet panicle^{-1}, percentage of filled grains, 1000-grain weight and grain yield. Three split application of potassium showed superiority over split application of 2, 1 and 4 splits. BR11 produced lower number of sterile spikelets than Nizersail.

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