

IMPACTS OF NITROGEN AND POTASSIUM MANAGEMENT ON YIELD OF TRANSPLANT AMAN RICE

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ABSTRACT

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during July to November, 2019 with a view to finding out the effect of variety and nitrogen and potassium management on yield and yield attributes of transplant *aman* rice. The experiment comprised of two rice varieties viz. BRRI dhan34 and BRRI dhan49 and six levels of nitrogen and potassium management viz. F₁-Recommended rate of fertilizer (Control), F₂-Recommended rate + 25% additional Nitrogen at 7 days after panicle initiation (DAPI), F₃-Recommended rate + 25% additional potassium at 7 DAPI, F₄-Recommended rate + 25% additional Nitrogen + 25% additional potassium at 7 DAPI, F₅-Recommended rate + foliar spray of 2% urea & 1% MoP at 7 DAPI and F₆-Recommended rate + foliar spray of 2% urea & 1% MoP at 7 and 14 DAPI. The results of the experiment revealed that the main effect for varieties and nitrogen and potassium management were significant for grain yield but not significant due to the interaction between variety and nitrogen and potassium management. BRRI dhan49 gave the higher yield (7.13 t ha⁻¹) than BRRI dhan34 (5.38 t ha⁻¹). In respect to nitrogen and potassium management, the highest grain yield (7.34 t ha⁻¹) was obtained with recommended rate + 25% additional nitrogen+25% additional potassium at 7 DAPI which was statistically similar with other treatments and the lowest (5.42 t ha⁻¹) was found with recommended rate of fertilizer. Therefore, it may be concluded that the maximum yield of rice variety BRRI dhan34 and BRRI dhan49 could be obtained by applying additional 25% nitrogen and 25% potassium at 7 DAPI in addition to the recommended rates of fertilizers.

Key words: Nitrogen, potassium, yield, transplant aman rice.

Introduction

The population in Bangladesh is still growing by two million every year and may increase by another 30 million over the next 20 years. Thus, Bangladesh will require higher production of Rice. To reach the goal, it is necessary either to increase the crop area or to increase yield per unit area. The yield of rice per unit area is much lower in this country as compared to other rice growing countries of the world. The average yield of rice in Bangladesh is 3.2 t ha⁻¹ (BBS, 2020) and the yield of *aman* rice is (2.57 t ha⁻¹) (BBS, 2020). However, the potential for increasing *aman* rice production may be increased by manipulation of different agronomic practices. Bangladesh Rice Research Institute (BRRI) has released BRRI dhan34 as a high valued rice variety having small grain and pleasant aroma. BRRI dhan49, a variety of *aman* rice having fine grain like nijershail. It is developed for the region where water is logged for long time because it is a water logging resistant variety. No remarkable research work is held on it. So clarification is required in case of its agronomic practices such as Nitrogen and Potassium management for this particular cultivar in order to optimize the maximum yield.

Again, nitrogen plays a vital role in increasing protein in the grains, increases tillering, vegetative growth, grain and straw yields. Efficient fertilizer management gave higher yield of crop and reduces fertilizer cost (Hossain and Islam, 2006). Plant growth is seriously hampered when lower dose of nitrogen is applied which drastically reduces the yield. Potassium (K) is also essential for most of the biochemical and physiological processes related to plant development and it contributes to the resistance of rice plants to various abiotic stresses and helps in yield improvement (Wang *et al.*, 2008). Lack of K restricts the

establishment, development, and yield of crops. Potassium is required for the activity of many enzymes, including those of energy metabolism, protein synthesis, and solute transport. Also it contributes significantly to cell turgor, especially in Rice. The effect of supplemental application of N and K at early reproductive phase has not been studied yet. Therefore, the present study was undertaken to find out the effect of nitrogen and potassium management on yield and yield attributes of transplant *aman* rice.

Materials and Methods

An experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during 11 July to 25 November 2019 for assessing the impacts of nitrogen and potassium management on yield and yield contributing characters of two transplant *aman* rice varieties. The experiment consisted of two varieties viz. BRRI dhan34 and BRRI dhan49 and six levels of nitrogen and potassium management viz. F₁-Recommended rate of fertilizer (Control), F₂-Recommended rate + 25% additional Nitrogen at 7 days after Panicle Initiation (DAPI), F₃-Recommended rate + 25% additional potassium at 7 DAPI, F₄-Recommended rate + 25% additional Nitrogen + 25% additional potassium at 7 DAPI, F₅-Recommended rate + foliar spray of 2% urea & 1% MOP at 7 DAPI and F₆-Recommended rate + foliar spray of 2% urea & 1% MOP at 7 and 14 DAPI. The variety was assigned to the main plot and the nitrogen and potassium management was allocated in the sub-plot randomly. The total number of plots was 36 (2×6×3). The size of unit plot was 2.5 m × 2.0 m (5 m²). The land was fertilized with the recommended rates of fertilizer. N, P, K, S and Zn were applied in the form of Urea, triple super phosphate, muriate of potash, gypsum and Zinc sulphate @ 70, 12, 60, 9.1 and 1.5 kg ha⁻¹, respectively. Urea was applied 3 equal splits at 15, 30 and 45 DAT. Thirty five days old seedlings were transplanted on 5 August, 2019 at 25 cm × 15 cm spacing allocating 3 seedlings hill⁻¹. Intercultural operations were done as and when necessary. The crop was harvested at maturity on 25 November 2019 and the grain yield was recorded at 14% moisture level. Before harvest, four hills were randomly selected and uprooted from each unit plot to record the data on crop characters and yield contributing characters. Data recorded for yield and yield contributing characters were compiled and tabulated in proper form for statistical analyses. Analysis of variance was done with the help of Statistix 10 computer package programme. The mean differences among the treatments were evaluated with Tukey's test (Gomez and Gomez, 1984).

Results and Discussion

The effect of variety was significant for the studied entire variables (Table 1) but not significant for straw yield (t ha⁻¹). BRRI dhan34 produced taller plant (145.89cm) than BRRI dhan49 (102.75 cm). Tyebet *al.* (2013) observed variation in plant height due to varietal differences.

Table 1. Effect of variety on yield and yield contributing characters of transplant *aman* rice

Variety	Plant height (cm)	No. of total tillers hill ⁻¹	No. of effective tillers hill ⁻¹	Non-effective tillers hill ⁻¹	Panicle length (cm)	No. of filled grains panicle ⁻¹	No. of unfilled spikelet panicle ⁻¹	1000-grains weight (g)	Harvest index (%)
BRRI dhan34 (V ₁)	145.89a	19.24a	17.03a	2.21a	25.77a	190.03a	20.91a	10.42b	36.41
BRRI dhan49 (V ₂)	102.75b	15.69b	14.11b	1.68b	21.89b	130.93b	12.98b	20.32a	40.85
Level of sig.	**	**	**	*	**	**	**	**	NS
SEM (±)	1.97	0.33	0.37	0.08	0.23	0.90	0.64	0.08	1.24
CV%	4.77	5.59	7.20	13.03	2.85	1.69	11.41	1.63	9.59

In a column figures with same letters or without letter do not differ significantly, whereas figures with dissimilar letters differ significantly (as per Tukey HSD), Level of sig. = Level of significance

*= Significant at 5% level of probability, **= Significant at 1% level of probability, NS = Not significant

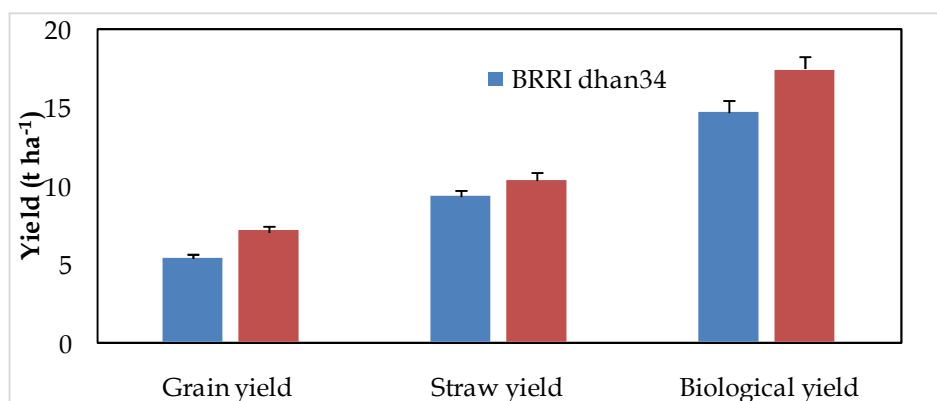


Fig. 1. Effect of variety on grain yield, straw yield and biological yield of transplant *aman* rice

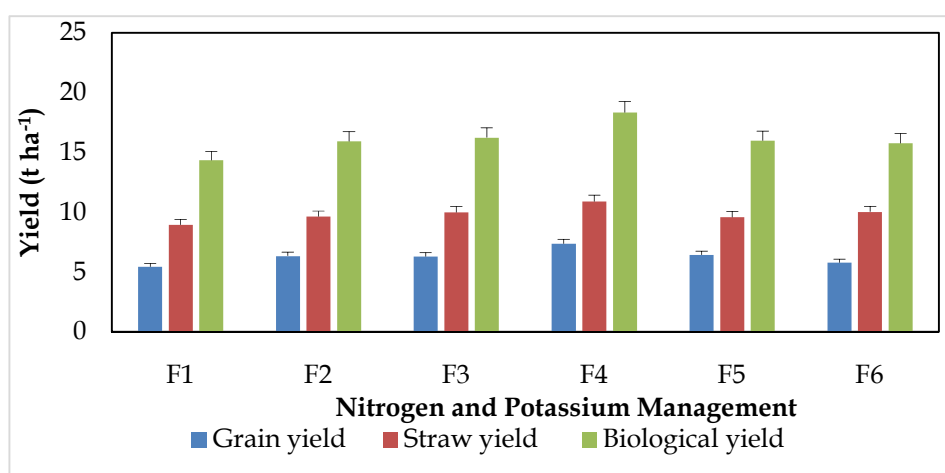


Fig. 2. Effect of N & K Management on yield (grain, straw and biological) of transplant *aman* rice

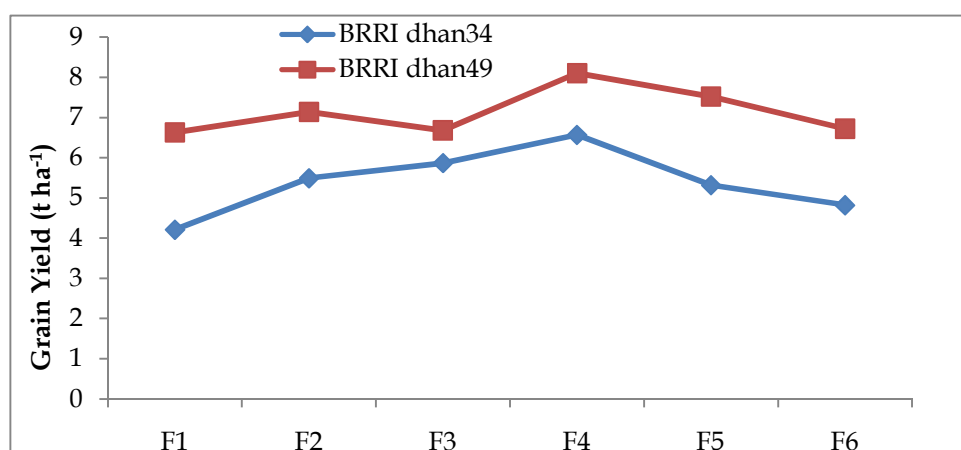


Fig. 3. Interaction effect of variety and fertilizer management on grain yield of transplant *aman* rice

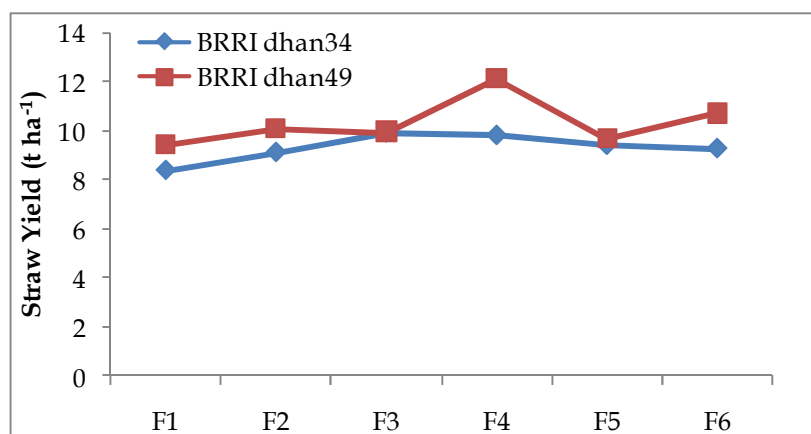


Fig. 4. Interaction effect of variety and fertilizer management on straw yield of transplant *aman* rice

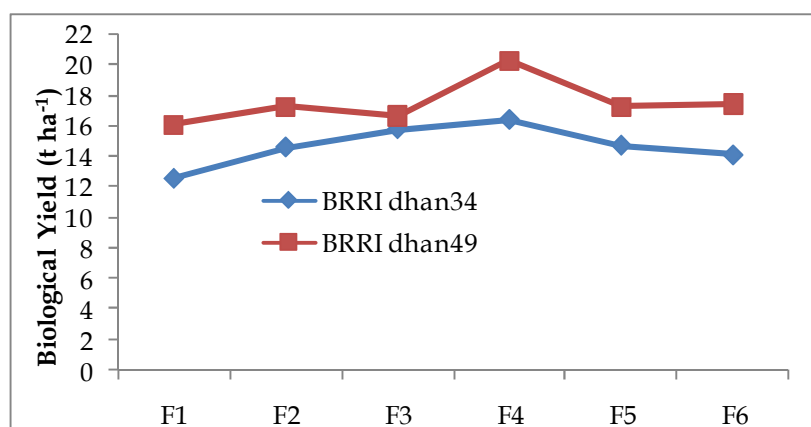


Fig. 5. Interaction effect of variety and fertilizer management on biological yield of transplant *aman* rice

Table 2. Effect of nitrogen and potassium management on yield and yield contributing characters of transplant *aman* rice

Fertilizer	Plant height (cm)	No. of total tillers hill ⁻¹	No. of effective tillers hill ⁻¹	Non-effective tillers hill ⁻¹	Panicle length (cm)	No. of filled grains panicle ⁻¹	No. of unfilled spikelet panicle ⁻¹	1000-grains weight (g)	Harvest index (%)
F ₁	122.79	17.54	15.67	1.88	23.68	153.92ab	16.44ab	15.27	37.33
F ₂	124.38	18.29	16.50	2.13	24.05	159.86ab	19.34a	15.37	39.49
F ₃	125.38	15.38	14.04	1.33	23.38	164.18ab	15.43b	15.42	38.62
F ₄	127.33	16.79	14.96	1.83	24.18	171.50a	16.10ab	15.45	40.00
F ₅	122.17	18.04	15.75	2.25	23.78	162.65ab	16.33ab	15.37	39.85
F ₆	123.88	18.75	16.50	2.25	23.90	150.76b	18.01ab	15.35	36.50
Level of sig.	NS	NS	NS	NS	NS	*	*	NS	NS
SEM (±)	1.8418	1.86	1.59	0.42	0.50	5.69	1.18	0.16	1.78
CV%	2.57	18.48	17.70	37.80	3.66	6.14	12.11	1.81	7.98

In a column figures with same letters or without letter do not differ significantly, whereas figures with dissimilar letters differ significantly (as per Tukey HSD), Level of sig. = Level of significance

*= Significant at 5% level of probability, **= Significant at 1% level of probability, NS = Not significant

Table 3. Interaction effect of variety and nitrogen & potassium management on yield and yield contributing characters of transplant *aman* rice

Interaction	Plant height (cm)	No. of total tillers hill ⁻¹	No. of effective tillers hill ⁻¹	Non-effective tillers hill ⁻¹	Panicle length (cm)	No. of filled grains panicle ⁻¹	No. of unfilled spikelet panicle ⁻¹	1000-grains weight (g)	Harvest index (%)
V ₁ F ₁	142.83	20.83	18.33	2.50	25.53	182.13	20.45	10.37	33.32
V ₁ F ₂	146.42	20.67	18.33	2.33	25.67	193.95	24.15	10.37	37.66
V ₁ F ₃	148.08	17.33	15.83	1.50	26.00	199.07	18.67	10.53	36.93
V ₁ F ₄	149.42	18.17	16.42	1.75	26.05	199.03	20.22	10.57	39.97
V ₁ F ₅	143.33	18.58	16.25	2.33	25.70	191.67	19.43	10.40	36.07
V ₁ F ₆	145.25	19.83	17.00	2.83	25.67	174.30	22.52	10.30	34.52
V ₂ F ₁	102.75	14.25	13.00	1.25	21.83	125.70	12.43	20.17	41.33
V ₂ F ₂	102.33	15.92	14.67	1.92	22.43	125.77	14.53	20.37	41.33
V ₂ F ₃	102.67	13.42	12.25	1.17	20.77	129.30	12.18	20.30	40.31
V ₂ F ₄	105.25	15.42	13.50	1.92	22.32	143.97	11.98	20.37	40.03
V ₂ F ₅	101.00	17.50	15.25	2.17	21.85	133.63	13.23	20.34	43.64
V ₂ F ₆	102.50	17.67	16.00	1.67	22.13	127.22	13.50	20.40	38.48
Level of sig.	NS	NS	NS	NS	NS	NS	NS	NS	NS
SEM (±)	2.60	2.63	2.25	0.60	0.71	10.93	1.71	0.23	2.74
CV%	2.57	18.48	17.70	37.80	3.66	6.14	12.11	1.81	7.98

In a column figures with same letters or without letter do not differ significantly, whereas figures with dissimilar letters differ significantly (as per Tukey HSD), Level of sig. = Level of significance

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Higher number of total tillers hill⁻¹ (19.24), effective tillers hill⁻¹ (17.03), non-effective tillers hill⁻¹ (2.21), panicle length (25.77 cm), number of filled grains panicle⁻¹ (190.03) and number of unfilled spikelet panicle⁻¹ (20.91) were found in BRR1 dhan34 but 1000-grains weight (20.32g), grain yield (7.13 t ha⁻¹), Straw yield (10.36 t ha⁻¹), biological yield (17.49 t ha⁻¹) and Harvest index (40.85 %) were obtained higher from BRR1 dhan49. Lower number of total tillers hill⁻¹ (15.59), effective tillers hill⁻¹ (14.11), non-effective tillers hill⁻¹ (1.68), panicle length (21.89 cm), number of filled grains panicle⁻¹ (130.93) and number of unfilled spikelet panicle⁻¹ (12.98) were found in BRR1 dhan49 while 1000-grains weight (10.42g), grain yield (5.38 t ha⁻¹), Straw yield (9.34 t ha⁻¹), biological yield (14.72 t ha⁻¹) as shown in Fig. 1 and Harvest index (36.41 %) were lower in BRR1 dhan34. The yield variation between the varieties is caused due to their genetic potential.

Nitrogen and potassium management had significant influence on number of filled grains panicle⁻¹, No. of unfilled spikelet panicle⁻¹, Grain yield (t ha⁻¹) and Biological yield (t ha⁻¹) but not significant on the other variables (Table 2). The tallest plant (127.33 cm) was found with F₄ and the shortest plant (122.17 cm) in F₅. The highest number of total tillers hill⁻¹ (18.75) were recorded with F₆ and the lowest (15.38) in F₃. The highest numbers of effective tillers hill⁻¹ (16.50) were recorded with both F₂ and F₆ and the lowest (14.04) in F₃. The highest number of non-effective tillers hill⁻¹ (2.25) was recorded with both F₅ and F₆ and the lowest (1.33) in F₃ was produced in F₄ and the shortest panicle (24.18 cm) in F₃. The maximum number of filled grains panicle⁻¹ (171.50) in F₄ and the minimum (150.76) in F₆. The maximum number of unfilled spikelet panicle⁻¹ (19.34) in F₂ in F₃. The highest 1000-grain Weight (15.45g) was noted in F₄ and the lowest (15.27g) in F₁. The highest grain yield (7.34 t ha⁻¹) was found in F₄ and the lowest (5.24 t ha⁻¹) in F₁. The highest straw yield (10.90 t ha⁻¹) was found in F₄ and the lowest (8.93) in F₁. The highest biological yield (18.33 t ha⁻¹) was found in F₄ and the lowest (14.35 t ha⁻¹) in F₁ (Fig. 2). The highest harvest index (40.00 %) was found in F₄ and the lowest (36.50%) in F₆.

Interaction effect of variety and fertilizer management on yield and yield contributing characters of transplant *aman* rice was not significant for any of the variables studied (Table 3 and Figs. 3-5).

Conclusion

It could be concluded that BRRI dhan34 and BRRI dhan49 could give high yield when fertilizers are applied at recommended rate of fertilizer with additional 25% nitrogen and 25% potassium at 7 days after Panicle Initiation (DAPI).

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