Impact of nutrient management on the growth performance of transplant *Aman* rice

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Abstract: The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, Bangladesh during June to December 2016 to investigate the influence of plant nutrient management on the growth performance of four transplant *Aman* rice varieties viz. BRRI dhan70, BRRI dhan71, BRRI dhan72 and BRRI dhan73. Six nutrient managements viz. poultry manure 5 t ha^{-1}, recommended dose of prilled urea, P, K, S, Zn (160, 65, 90, 70, 10 kg ha^{-1} of Urea, TSP, MoP, Gypsum and Zinc sulphate, respectively), 75% of recommended dose of prilled urea and P, K, S, Zn + poultry manure 2.5 t ha^{-1}, 50% of recommended dose of prilled urea and P, K, S, Zn + poultry manure 5 t ha^{-1}, USG 1.8 g/4 hills and P, K, S, Zn recommended dose, USG 1.8 g/4 hills and P, K, S, Zn + poultry manure 2.5 t ha^{-1} were used in this experiment . The experiment was laid out in a randomized complete block design with three replications. Results of the experiment showed that variety and integrated nutrient management had significant effect on plant height, number of tillers hill^{-1}, dry matter hill^{-1} and leaf area index (LAI) of transplant *Aman* rice. At 55, 70 and 85 DAT the tallest plant was found in BRRI dhan70. BRRI dhan70 produced the highest number of tillers hill^{-1} at 70 and 85 DAT whereas at 55 DAT the tallest plant was found in BRRI dhan73, and BRRI dhan73 was produced the highest dry matter hill^{-1} at 55, and 85 DAT whereas BRRI dhan72 recorded the highest at 70 DAT while BRRI dhan73 produced higher LAI in compare to other varieties at 65 DAT. USG 1.8 g/4 hills and P, K, S, Zn recommended dose can produced tallest plant, higher number tillers hill^{-1} and higher LAI whereas USG 1.8 g hill and P, K, S, Zn + poultry manure 2.5 t ha^{-1} was produced the highest dry matter hill^{-1}. Among the interaction BRRI dhan73 fertilized with USG 1.8 g/4 hills and P, K, S, Zn recommended dose appears as the promising combination in respect of growth performance of transplant *Aman* rice.

Key words: Variety, integrated nutrient management, growth, transplant *Aman* rice.

Introduction

Rice (*Oryza sativa*) is the most extensively cultivated and major food grain crop of Bangladesh. In Bangladesh, there are three distinct rice growing seasons such as *Aus*, *Aman* and *Boro*. Among them, the largest harvest is obtained from *Aman*, occurring in November and December accounting for more than half of the area coverage. *Aman* rice covers the largest area of 5.6 million hectares with a production of 13.1 million tons of rice (BBS, 2016). Integrated nutrient management is an important factor, which plays a significant role on growth, development, and yield of rice at its optimum level, which provides scope to the plants for efficient utilization of nutrients. A suitable combination of organic and inorganic supplies of nutrients is essential for sustainable agriculture that will provide food with superior quality. Sengar *et al*. (2000) stated that the application of chemical fertilizers in combination with manures improved the fertility status of the soil. The long term research of BRRI reveals that the addition of cow dung @ 5 t ha^{-1} yr^{-1} improves the rice productivity as well as prevents the soil resources from degradation (Bhuiyan, 1994). An upgrading and continuation of a good supply of organic matter is essential for sustenance of soil fertility and crop productivity. The growth parameter, leaf area index (LAI) is a dimensionless variable and was first defined as the total one-sided area of photosynthetic tissue per unit ground surface area (Inge *et al*., 2004). Leaf area index (LAI) can have importance in many areas of agronomy and crop production through its influence: light interception, crop growth, weed control, crop-weed competition, crop water use and soil erosion (Sonnetag *et al*., 2007 and Paul *et al*., 2014). Combined application of inorganic fertilizer with manure significantly influenced the growth of transplant *Aman* rice (Jahan *et al*., 2017). Therefore, this study was undertaken to analyze the growth parameters of four transplant *Aman* rice using six combination of nutrient management approaches.

Materials and Methods

The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University (BAU), Mymensingh, during June to December 2016 to study the influence of plant nutrient management on the growth performance of transplant *Aman* rice varieties. The land was medium high and the soil was silt-loam, well drained having pH 5.9. The experiment comprised four varieties viz. BRRIdhan70, BRRI dhan71, BRRI dhan72 and BRRIdhan73 and six nutrient managements viz. poultry manure 5 t ha^{-1}, recommended dose of prilled urea, P, K, S, Zn (160, 65, 90, 70, 10 kg ha^{-1} of Urea, TSP, MoP, Gypsum and Zinc sulphate, respectively), 75% of recommended dose of prilled urea and P, K, S, Zn + poultry manure 2.5 tha^{-1}, 50% of recommended dose of prilled urea and P, K, S, Zn + poultry manure 5 t ha^{-1}, USG 1.8 g/4 hills and P, K, S, Zn recommended dose, USG 1.8 g/4 hills and P, K, S, Zn + poultry manure 2.5 tha^{-1}. The experiment was laid out in a randomized complete block design with three replications. The size of unit plot was 4.0 × 2.5 m. The manures and fertilizers were applied in the form of Poultry manure, Urea, Triple Super Phosphate and Muriate of Potash, Zypsum and Zinc sulphate, respectively as per treatments were applied at final land preparation as per treatment requirements. Urea was top dressed in three equal splits at 15, 30 and 45 days after transplanting (DAT). As per experimental specification USG were placed manually (depth 6-8 cm) at the centre of four hills of two adjacent rows at 8 days after transplanting (DAT). Five hills were marked by bamboo stick excluding boarder rows to collect data on plant height and tiller number. Four hills were destructed at every sampling dates for total dry matter hill^{-1}. Plant height, number of tillers hill^{-1} and dry matter hill^{-1} were recorded at every 15 Days interval beginning from 55 DAT up to 85 DAT and leaf area index was taken 65 DAT. The leaf area was measured by an automatic leaf area meter (Type AAN-7, Hayashi Dam Ko Co., Japan). Leaf area index was calculated as the ratio of total leaf area and total ground area of the sample as

described by Hunt (1978). {LAI = (LA÷P)}, Where, LAI = Leaf Area Index, LA = Leaf Area; P = Ground Area.
The recorded data were statistically analyzed using the "Analysis of Variance" technique and the differences among treatment means were adjudged by Duncan's New Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

Impact of variety: Growth parameters viz. plant height, number of tillers hill^{-1}, dry matter hill^{-1} and leaf are area index (LAI) were influenced by variety. Plant height in all the varieties increased progressively with the advancement of time from 55 to 85 DAT. BRRI dhan70 showed superiority in plant height followed by BRRI dhan72, BRRI dhan73 and BRRI dhan74 (Table 1). Varietal differences regarding plant height might be due to their differences in genetic constitution. Similar results were reported elsewhere (Ray *et al*., 2015; Kirttania *et al*. 2013; and Tyeb *et al*., 2013). The number of total tillers hill^{-1} was significantly influenced by variety at all dates of transplanting (Table 1). The highest number of tillers hill^{-1} was found in 55 DAT but it decreased in all the varieties at 70 DAT. The highest number of tillers hill^{-1} was produced by BRRI dhan70 which was as good as BRRI dhan73 and BRRI dhan72 and the lowest one in BRRI dhan71. Kirttania *et al*. (2013) found that variable effect of variety on number of tillers hill^{-1}. Result showed that BRRI dhan73 produced the highest dry matter hill^{-1} at all sampling dates except 70 DAT. The variety had significantly effect on leaf area index on 65 DAT. BRRI dhan73 showed superiority followed by BRRI dhan72 and the lowest one in BRRI dhan71.

Table 1. Effect of Variety on various growth parameters of transplant *Aman* rice

Variety	Plant height (cm)			No. of total tillers hill^{-1}			Dry matter hill^{-1}(g)			Leaf Area Index
	Days after transplanting (DAT)			Days after transplanting (DAT)			Days after transplanting (DAT)			
	55	70	85	55	70	85	55	70	85	65
BRRI dhan70	101.6a	124.3a	144.1a	13.65ab	9.32a	8.86a	12.46d	29.5b	33.81c	5.55a
BRRI dhan71	99.38b	120.5b	123.2c	11.58c	8.90b	8.60a	13.71c	29.01b	33.71c	4.72b
BRRI dhan72	98.85b	127.4a	131.2b	13.04b	8.41c	8.17b	15.04b	30.68a	39.66b	5.7a
BRRI dhan73	97.79b	116.8c	129.5b	14.31a	8.47c	7.82c	16.01a	27.45c	45.70a	5.79 a
$S\bar{x}$	0.715	1.25	1.65	0.34	0.09	0.11	0.18	0.36	0.39	0.09
LS	**	**	**	**	**	**	**	**	**	**
CV (%)	3.06	4.34	5.32	10.82	4.73	5.58	5.23	5.38		6.88

In a column, figures with same letter (s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT). ** =Significant at 1% level of probability.

Impact of nutrient management: The plant height was significantly influenced due to application of organic and inorganic fertilizers. A trend of significant of increase in the plant height was observed at all the dates of observation from 55 to 85 DAT (Table 2). The highest plant height was observed when the plant was fertilized with USG 1.8 g/4 hills and P, K, S, Zn recommended dose and the lowest plant height was recorded in poultry manure 5 t ha^{-1}. Application of organic and inorganic fertilizer increased plant height was reported elsewhere (Pal *et al*., 2016; Islam *et al*., 2015; and Sarkar *et al*., 2016). The effect of integrated fertilizer application on the number of total tillers hill^{-1} was significantly influenced at all the dates sampling (Table 2). The number of tillers hill^{-1} increased with the combination of organic and inorganic fertilizers. Application of USG 1.8 g/4 hills and P, K, S, Zn recommended dose was produced the highest number of tillers hill^{-1} at all dates of samplings. In respect of dry matter hill^{-1}, application of USG 1.8 g hill and P, K, S, Zn + poultry manure 2.5 t ha^{-1} recorded the highest whereas the lowest one in poultry manure 5t ha^{-1}. Integrated nutrient management has significant effect on leaf area index (LAI) at 65 DAT (Table 2). USG 1.8 g/4 hills and P, K, S, Zn recommended dose produced the highest LAI followed by USG 1.8 g hill and P, K, S, Zn + poultry manure 2.5 t ha^{-1}.

Table 2. Effect of nutrient management on various growth parameters of transplant *Aman* rice

Nutrient management	Plant height (cm)			No. of total tillers hill^{-1}			Dry matter hill^{-1} (g)			Leaf Area Index
	Days after transplanting (DAT)			Days after transplanting (DAT)			Days after transplanting (DAT)			
	55	70	85	55	70	85	55	70	85	65
F_0	93.04d	116.7d	123.2c	12.77	8.39c	7.75c	11.11e	24.9d	37.85c	3.68d
F_1	99.02bc	120.6cd	130.0b	12.35	8.49bc	7.94c	13.16d	25.49d	39.38b	4.69c
F_2	98.1c	122.6abc	130.8b	13.17	8.38c	7.71c	14.85c	28.83c	36.60c	4.97c
F_3	101.4ab	121.4bc	133.4b	13.60	8.79b	8.77b	15.62b	31.2b	40.15b	5.55b
F_4	102.5a	126.8a	139.8a	13.31	9.44a	9.29a	13.27d	34.67a	32.8d	8.27a
F_5	102.3a	125.6ab	134.8ab	13.67	9.16a	8.71b	17.83a	29.81c	42.49a	5.6b
$S\bar{x}$	0.88	1.53	2.02	0.41	0.12	0.13	0.216	0.451	0.479	0.11
LS	**	**	**	NS	**	**	**	**	**	**
CV (%)	3.06	4.34	5.32	10.82	4.73	5.58	5.23	5.38	4.35	6.88

In a column, figures with same letter (s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT). ** =Significant at 1% level of probability, F_0 = Poultry manure 5t ha^{-1}, F_1 = Recommended dose of prilled urea, P, K, S, Zn (100, 65, 90,70, 10 kg ha^{-1} of Urea, TSP, MoP, Gypsum and Zinc sulphate respectively), F_2 = 75% of recommended dose of prilled urea and P, K, S, Zn + poultry manure 2.5 t ha^{-1}, F_3 = 50% recommended dose of prilled urea and P, K, S, Zn + poultry manure 5 t ha^{-1}, F_4 = USG 1.8 g/4 hills and P, K, S, Zn recommended dose, F_5 = USG 1.8 g hill and P, K, S, Zn + poultry manure 2.5 t ha^{-1}.

Interaction effect: Plant height was significantly influenced by the interaction of variety and nutrient management at 55 DAT. At 55 DAT, numerically the tallest plant height of 105.0 cm was found in the treatment combinations of $V_1 \times F_3$ (BRRI dhan70 x 50% recommended dose of prilled urea and P, K, S, Zn + poultry manure 5 t ha^{-1}) followed by $V_4 \times F_4$ (BRRI dhan73 x USG 1.8 g/4 hills and P, K, S, Zn recommended dose) and the shortest plant height of 90.17 cm was found in $V_4 \times F_0$ (BRRI dhan73 × poultry manure 5 t ha^{-1} (Table 3). A regular trend of increased the plant height in the treatment combinations of all the varieties with the combination of organic and inorganic fertilizer. At 55 DAT showing superiority of BRRI dhan70 and was followed in successive by BRRI dhan73, BRRI dhan72 and BRRI dhan71. BRRI dhan70 showed superiority over the treatment combinations of BRRI dhan71, BRRI dhan72, BRRI dhan73 and nutrient management. The interaction effect of variety and nutrient management of on numbers of tillers hill^{-1} was significant at all dates of sampling (Table 3). A trend of increase in the number of tillers hill^{-1} with the combination of organic and inorganic fertilizer was observed in all the varieties. The highest number of tillers hill^{-1} was produced in the combination of BRRI dhan73 and 75% of recommended dose of prilled urea and P, K, S, Zn + poultry manure 2.5 t ha^{-1}. The highest dry matter hill^{-1} was found in the combination of $V_4 \times F_0$ (BRRI dhan73 x poultry manure 5 t ha^{-1}) and the lowest one in $V_3 \times F_0$ (BRRI dhan72 x poultry manure 5 tha^{-1}).The interaction effect of variety and nutrient management on LAI was significant on 65 DAT. The highest LAI was observed in the interaction of $V_4 \times F_4$ (BRRI dhan73 × USG 1.8 g/4 hills and P, K, S, Zn recommended dose) followed by $V_1 \times F_4$ (BRRI dhan70 × USG 1.8 g/4 hills and P, K, S, Zn recommended dose) and the lowest one in $V_1 \times F_0$ (BRRI dhan70 × Poultry manure 5t ha^{-1}) (Table 3).

Table 3. Interaction effect of variety and integrated nutrient management on various growth parameters of transplant *Aman* rice

Interaction (Variety x Nutrient management)	Plant height (cm)			No. of total tillers hill^{-1}			Dry matter hill^{-1}(g)			Leaf area index
	Days after transplanting (DAT)			Days after transplanting (DAT)			Days after transplanting (DAT)			
	55	70	85	55	70	85	55	70	85	65
$V_1 \times F_0$	91.25ij	116.83	129.00	15.92ab	8.92ef	7.83g	10.30k	24.96k	30.4kl	2.9 l
$V_1 \times F_1$	103.0cd	121.58	143.42	11.33gh	8.83fg	8.08h	11.53ij	25.54ij	41.85f	4.63hi
$V_1 \times F_2$	102.8cd	124.58	138.17	13.42fg	9.0cde	8.17h	8.31l	28.45h	31.29k	5.5efg
$V_1 \times F_3$	105.5a	125.08	150.25	13.92fg	9.92ab	9.42bc	9.61k	28.73h	43.32e	6.1cde
$V_1 \times F_4$	103.7ab	130.50	156.67	14.17ef	10.25a	10.33a	13.95g	39.42b	27.87l	9.5a
$V_1 \times F_5$	103.2bc	127.00	147.08	13.17fg	9.0cde	9.35bc	21.07a	30.01f	28.09l	4.5hi
$V_2 \times F_0$	97.17gh	115.75	116.92	11.25gh	8.17ij	7.75h	12.5hi	25.4ij	38.43g	3.1 kl
$V_2 \times F_1$	100.fg	121.08	121.83	11.9gh	9.58bc	8.68ef	14.17g	23.72k	23.7m	3.39kl
$V_2 \times F_2$	98.25gh	120.25	126.83	9.50h	7.42jk	7.50h	12.3hi	29.86g	34.8hi	5.49efg
$V_2 \times F_3$	101.0ef	120.50	122.67	11.33gh	9.42cd	8.92e	17.6e	26.37j	33.82ij	3.74jk
$V_2 \times F_4$	98.25gh	121.08	123.50	12.83fg	8.65fg	9.08c	11.43ij	35.2c	32.19k	6.21cd
$V_2 \times F_5$	101.3ef	124.58	127.33	12.6fg	10.17b	9.67ab	14.07g	33.3d	39.2fg	6.32cd
$V_3 \times F_0$	93.58ij	123.17	125.92	11.98gh	8.92ef	8.83e	10.65k	25.12k	27.6l	3.52kl
$V_3 \times F_1$	97.33gh	127.08	129.17	12.50fg	7.250k	7.58h	14.09g	28.91h	42.61e	5.05fghi
$V_3 \times F_2$	96.58hi	129.17	129.83	13.50fg	8.66fg	7.75h	19.67b	32.8d	34.43i	4.35ij
$V_3 \times F_3$	100.1fg	124.08	128.17	14.75cd	8.093ij	8.16eh	18.27cd	42.98a	45.07cd	7.61b
$V_3 \times F_4$	103.3bc	132.25	139.42	11.50gh	8.835g	9.00cd	12.37hi	31.82e	34.56hi	7.54b
$V_3 \times F_5$	102.3e	128.83	134.75	14.00fg	8.75efg	7.67h	15.18f	22.39k	53.69a	6.57c
$V_4 \times F_0$	90.17j	110.92	120.99	11.92gh	7.58ijk	6.58i	10.89jk	24.16ijk	54.88a	5.08fgh
$V_4 \times F_1$	95.42ij	112.75	125.75	13.67fg	8.333ghi	7.43h	12.83gh	23.81jk	49.33b	5.67ef
$V_4 \times F_2$	94.84ij	116.33	128.50	16.25a	8.41efgh	7.42h	19.03bc	24.1ijk	45.86c	4.52hi
$V_4 \times F_3$	99.00gh	115.75	132.33	14.42de	7.75hijk	8.58efg	16.97e	27.0ghi	38.38g	4.72hi
$V_4 \times F_4$	105.0a	123.42	139.42	14.75cd	10.00ab	8.75cde	15.33f	32.16de	36.84gh	9.84a
$V_4 \times F_5$	102.3de	121.92	129.92	14.83bc	8.750fg	8.1fgh	20.99a	33.43cd	48.89b	4.92ghi
$S\bar{x}$	1.75	3.07	4.05	0.82	0.24	0.26	0.43	0.90	0.96	0.22
Level of sig.	**	NS	NS	**	**	**	**	**	**	**
CV (%)	3.06	4.34	5.32	10.82	4.73	5.58	5.23	5.38	4.35	6.88

In a column, figures with same letter (s) or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT). ** =Significant at 1% level of probability, V_1 = BRRI dhan70, V_2 = BRRI dhan71, V_3 = BRRI dhan73, V_4 = BRRI dhan74, F_0 = Poultry manure 5 t ha^{-1}, F_1 = Recommended dose of prilled urea, P, K, S, Zn (100, 65, 90,70, 10 kg ha^{-1} of urea, TSP, MoP, Gypsum and Zinc sulphate respectively), F_2 = 75% of recommended dose of prilled urea and P, K, S, Zn + poultry manure 2.5 t ha^{-1}, F_3 = 50% recommended dose of prilled urea and P, K, S, Zn + poultry manure 5 t ha^{-1}, F_4 = USG 1.8 g/4 hills and P, K, S, Zn recommended dose, F_5 =USG 1.8 g hill and P, K, S, Zn + poultry manure 2.5 t ha^{-1}.

From this study it is clear that BRRI dhan70 produced tallest plant and higher number of tillers hill^{-1} at all dates of sampling while BRRI dhan73 produced higher dry matter hill^{-1} and LAI in compare to other varieties. USG 1.8 g/4 hills and P, K, S, Zn recommended dose produced the tallest plant, higher number tillers hill^{-1} and higher LAI. It can be concluded that BRRI dhan73 fertilized with USG 1.8 g/4 hills and P, K, S, Zn recommended dose appears as the promising combination in respect of growth of transplant *Aman* rice.

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