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YIELD PERFORMANCE OF FOUR TRANSPLANT *AMAN* RICE VARIETIES AS INFLUENCED BY NPKS FERTILIZATION

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Abstract: This study was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University (BAU), Mymensingh, during July to December 2006 to study the yield performance of four Transplant *Aman* (T. *Aman*) rice varieties as influenced by NPKS fertilization. The experiment consisted of four varieties of rice viz. BRRI dhan30, BRRI dhan31, BRRI dhan40 and BRRI dhan41; and four levels of fertilizers viz. zero level (control), low level of fertilizer (50% of the recommended dose of NPKS), recommended level of fertilizer (100% of the recommended dose of NPKS) and high level of fertilizer (150% of recommended dose of NPKS). The experiment was laid out in a split-plot design with three replications. Effect of variety was significant in respect of all growth and yield attributes except number of total tillers hill^{-1}, panicle length and 1000-grain weight. The highest grain yield (5.60 t ha^{-1}), highest straw yield (6.77 t ha^{-1}) and biological yield (12.36 t ha^{-1}) were obtained from BRRI dhan41. Effect of fertilizer was significant in respect of all growth characters and yield attributes except panicle length and 1000-grain weight. The highest grain yield (5.78 t ha^{-1}) was obtained in recommended level of fertilizer and the lowest yield (4.57 t ha^{-1}) was recorded in the control treatment. The significant interaction between variety and fertilizer level showed that the highest grain yield (6.29 t ha^{-1}) was achieved in the interaction of BRRI dhan41 and recommended level of fertilizer dose.
Key Words: Yield, Rice variety, NPKS fertilizer, T. *Aman*

Introduction

Rice is grown in Bangladesh in diverse ecosystems e.g. irrigated, rainfed and deepwater conditions in three distinct seasons namely, *Aus*, *Aman* and *Boro*. Before 1980's, deficiency of NPK was a major problem of Bangladesh soils, but thereafter, along with NPK, deficiencies of S and Zn are frequently reported (Haque and Jahiruddin, 1994). Presently there has been a great increase in fertilizer use, yet the proportion of different nutrients used in the country is not at all balanced. The total area and production of rice in Bangladesh in about 11.53 million hectares and 26.53 million metric tons, respectively (BBS, 2006). The average yield of rice in Bangladesh is 2.32 t ha^{-1} which is low compare to world average of 3.83 t ha^{-1} (FAO, 2004). Modern varieties of rice need productive soil and fertilizer management for their proper growth and yield. Proper identification and management of soil fertility problems are pre-requisites for boosting crop production and sustaining higher yields over a long period of time. Among different rice groups, Transplant *Aman* rice covers about 52.46% of the total rice area and contributes to 44% of total rice production in the country (BBS, 2004). Moreover, a suitable combination of variety and rate of fertilizer in necessary in order to obtain better yield. Quite a large number of experiments have been carried out throughout the world to find out the optimum levels of fertilizer in rice. However, in our country sufficient research work has not been done on different levels of fertilizer (NPKS), especially with high yielding varieties of inbred rice. It is necessary to find out optimum rate of fertilizer to obtain satisfactory yield performance of Transplant *Aman* rice, particularly the high yield potential varieties.

Materials and Methods

The study was conducted at the Agronomy Field Laboratory, BAU (24^{0}75′ N latitude and 90^{0}50′ E longitude), Mymensingh, during the period from July to December 2006. The experimental treatment comprises four T. *Aman* rice varieties viz. BRRI dhan30, BRRI dhan31, BRRI dhan40 and BRRI dhan41; and four levels of fertilizer viz. zero level (control), low level of fertilizer (50% of the recommended dose of NPKS), recommended level of fertilizer (100% of the recommended dose of NPKS) and high level of fertilizer (150% of recommended dose of NPKS). The experiment was laid out in a split-plot design with three replications. The unit plot size was 4.0 m × 2.5 m. The experimental area was characterized by non-calcareous dark grey floodplain soil belonging to the Sonatola Soil Series under Old Brahmaputra Floodplain (Agro-ecological zone-9; UNDP and FAO, 1988). The nutrients N, P, K, S and Zn were applied in the form of urea, triple super phosphate, muriate of potash, gypsum and zinc suplhate, respectively. The recommended doses of fertilizers were 220, 50, 60, 35 and 5 kg ha^{-1} of urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate, respectively. Among those fertilizers, zinc sulphate was applied equally in all plots (i.e. recommended dose of zinc sulphate) during the final land preparation. Other fertilizers were applied according to treatment specification. Urea was top dressed in three equal splits at 15, 30 and 45 days after transplanting (DAT) according to treatment specification. Thirty-day old seedlings were transplanted on 5 August 2006 at the rate of three seedlings hill^{-1} maintaining a spacing of 25 cm × 15 cm. Intercultural operations were done as and when necessary. The crop was harvested at full maturity. A harvest area of 1 m × 1 m was selected in the middle portion of each unit plot. Grains were threshed, cleaned and sun-dried and the grain yield plot^{-1} was recorded at 14% moisture content. Straws were sun-dried properly. Finally grain and straw yields plot^{-1} were recorded and converted to t ha^{-1}. Data were recorded on plant height, number of total tillers hill^{-1}, number of effective tillers hill^{-1}, number of grains panicle^{-1}, grain yield and straw yield. The recorded data were compiled and tabulated for statistical analysis.

Analysis of variance was done with the help of computer package MSTAT. The mean differences among the treatments were adjudged with Duncan's Multiple Range Test (Gomez and Gomez, 1984).

Results and Discussion

Effect of variety

Plant height was significantly influenced by variety. The tallest plant (119.79 cm) was found in BRRI dhan41 followed by BRRI dhan40, BRRI dhan31 and BRRI dhan30. This result is in consistent with findings of Shamsuddin *et al*. (1988) that also reported a variable plant height existed of the varieties (Table 1). Number of total tillers hill^{-1} was not significantly influenced by variety (Table 1). Number of effective tillers hill^{-1} was significantly influenced by variety. The highest number of effective tillers hill^{-1} (13.92) was found in BRRI dhan41 followed by BRRI dhan40, BRRI dhan30 and BRRI dhan31, which was statistically identical to BRRI dhan40 (13.08) (Table 1). Number of grains panicle^{-1} was significantly influenced by variety. The highest number of grains panicle^{-1} (161.50) was found in BRRI dhan41 followed by BRRI dhan40, BRRI dhan30 and BRRI dhan31 (Table 1).

Table 1 Effect of variety on yield and yield contributing characters of T. *Aman* rice

Variety	Plant height (cm)	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of grains panicle^{-1}	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
V_1	111.48 d	16.92	12.75 ab	158.75 a	4.60 c	5.97 b
V_2	113.46 c	17.42	11.75 b	149.33 b	4.78 b	5.70 c
V_3	116.43 b	17.50	13.08 a	160.92 a	5.47 a	6.63 a
V_4	119.79 a	18.08	13.92 a	161.50 a	5.60 a	6.77 a
$S\overline{X}$	0.59	0.29	0.38	1.77	0.05	0.08
Level of significance	**	NS	**	**	**	**

In a column, figures with same letter or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT). ** = Significant at 1% level of probability, NS = Not significant, V_1, V_2, V_3 & V_4 = BRRI dhan30, 31, 40 & 41

BRRI (1994) reported that the number of grains panicle^{-1} was influenced significantly due to variety. Grain yield was significantly influenced by variety. The highest grain yield (5.60 t ha^{-1}) was achieved from BRRI dhan41 followed by BRRI dhan40, BRRI dhan31 and BRRI dhan30 (Table 1). Straw yield was significantly influenced by variety. The highest straw yield (6.77 t ha^{-1}) was found from BRRI dhan41 followed by BRRI dhan40, BRRI dhan30 and BRRI dhan31 (Table 1). It also reported that the average yield of rice in Bangladesh is around 2.36 t ha^{-1}, which is less than the world average (2.9 t ha^{-1}) and frustratingly below the highest ranking country (6.1 t ha^{-1}) (BBS, 2004).

Effect of fertilizer dose

Plant height was significantly influenced by different doses of fertilizer. The tallest plant (129.75 cm) was obtained from high level of fertilizer dose. The shortest plant (102.72 cm) was obtained from low level of fertilizer which was statistically identical (105.07 cm) to control treatment. These results explicitly confirm of similar results obtained by Reddy *et al*. (1988) who recorded a positive effect of fertilizer level on plant height (Table 2). Number of total tillers hill^{-1} was significantly influenced by different doses of fertilizer. The highest number of total tillers hill^{-1} (19.42) was found at recommended level of fertilizer dose. The lowest number of total tillers hill^{-1} (16.50) was found with the control treatment which was statistically identical (16.92) to low level of fertilizer (Table 2). Number of effective tillers hill^{-1} was significantly influenced by different doses of fertilizer. The highest number of effective tillers hill^{-1} (16.08) was found at recommended level of fertilizer and the lowest number of effective tillers hill^{-1} (10.25) was found with the control treatment which was statistically identical (10.92) to low level of fertilizer dose (Table 2). Pandey *et al*. (1991) also reported the similar results in T. *Aman* rice from their studies. Number of grains panicle^{-1} was significantly influenced by fertilizer. The highest number of grains panicle^{-1} (169.08) was obtained from recommended level of fertilizer and the lowest number of grains panicle^{-1} (147.42) was found in the control treatment (Table 2). Grain yield was significantly influenced by different doses of fertilizer. The highest grain yield (5.78 t ha^{-1}) was achieved from recommended level of fertilizer. The lowest grain yield (4.57 t ha^{-1}) was achieved from the control treatment, which was statistically identical (4.60 t ha^{-1}) with low level of fertilizer dose (Table 2). These results are in agreement with those obtained by Hussain and Sharma (1991) who observed that the grain yield increased significantly upto the application of recommended level of fertilizer and thereafter declined. Straw yield was significantly influenced by different doses of fertilizers. The highest straw yield (6.87 t ha^{-1}) was achieved from recommended level of fertilizer. The lowest straw yield (5.88 t ha^{-1}) was found from low level of fertilizer which was statistically identical (5.93 t ha^{-1}) to control treatment (Table 2). The increasing

fertilizer level increased grain yield upto recommended level of fertilizer and then declined. The increment of grain yield up to the recommended level of fertilizer application might be due to supply of available nutrients to the crop. Further, the increased level of fertilizer decreased grain yield significantly due to excessive plant growth and crop lodging.

Table 2 Effect of fertilizer level on yield and yield contributing characters of T. *Aman* rice

Fertilizer dose (kg ha^{-1})	Plant height (cm)	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of grains panicle^{-1}	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
F1	105.07 c	16.50 b	10.25 c	147.42 c	4.57 c	5.93 c
F2	102.72 c	16.92 b	10.92 c	151.00 bc	4.60 c	5.88 c
F3	123.63 b	19.42 a	16.08 a	169.08 a	5.78 a	6.87 a
F4	129.75 a	17.08 b	14.25 b	163.00 ab	5.50 b	6.39 b
S $\overline{X}$	0.65	0.42	0.39	2.88	0.05	0.03
Level of significance	**	**	**	**	**	**

In a column, figures with same letter or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT). ** = Significant at 1% level of probability.
F_1 = No fertilizer applied (control), F_2 = Low level of fertilizer (50% of the recommended dose of NPKS), F_3 = Recommended level of fertilizer (100% of the recommended dose of NPKS), F_4 = High level of fertilizer (150% of the recommended dose of NPKS).

Effect of interaction between variety and fertilizer dose

Plant height was significantly influenced by the interaction between variety and fertilizer dose. The tallest plant (137.75 cm) was found in the treatment combination of BRRI dhan41 and high level of fertilizer dose and the shortest plant (100.57 cm) was found in the treatment combination of BRRI dhan31 and recommended level of fertilizer (Table 3). Number of total tillers hill^{-1} was significantly influenced by the interaction between variety and fertilizer dose. The highest number of total tillers hill^{-1} (22.00) was found in the treatment combination of BRRI dhan41 and recommended level of fertilizer and the lowest number of total tillers hill^{-1} (15.67) was found in the treatment combination of BRRI dhan40 and control treatment which was statistically identical (16.00) to BRRI dhan30 and control treatment (Table 3). Number of effective tillers hill^{-1} was not significantly influenced by the interaction between variety and fertilizer dose (Table 3). Number of grains panicle^{-1} was not significantly influenced by the interaction between variety and fertilizer dose (Table 3). Grain yield was significantly influenced by the interaction between variety and fertilizer dose. The highest grain yield (6.29 t ha^{-1}) was obtained from the treatment combination of BRRI dhan41 and recommended level of fertilizer dose which was statistically identical to BRRI dhan40 (6.13 t ha^{-1}) and recommended level of fertilizer dose. The lowest grain yield (3.90 t ha^{-1}) was

Table 3 Interaction of variety and fertilizer level on yield and yield contributing characters of T. *Aman* rice

Interaction (Variety × Fertilizer dose)	Plant height (cm)	No. of total tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of grains panicle^{-1}	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})
V_1×F_1	110.14 e	16.00 e	10.00	155.33	4.00 h	5.40 fg
V_1×F_2	103.47 fg	17.00 cde	11.67	147.33	4.06 h	5.63 fg
V_1×F_3	112.06 e	18.33 bc	15.67	168.00	5.22 c-e	6.35 bc
V_1×F_4	120.26 d	16.33 de	13.67	164.33	5.11 de	6.50 bc
V_2×F_1	101.18 fg	18.00 cd	10.00	139.67	4.45 g	5.68 ef
V_2×F_2	103.47 fg	18.33 bc	9.00	142.67	3.90 h	5.17 g
V_2×F_3	120.54 d	17.33 cde	15.00	161.33	5.46 c	6.14 c-e
V_2×F_4	128.65 c	16.00 e	13.00	153.67	5.29 c-e	5.81 d-f
V_3×F_1	104.48 f	15.67 e	10.67	150.33	4.80 f	6.17 c-e
V_3×F_2	100.57 g	16.33 de	11.67	156.67	5.10 de	6.47 bc
V_3×F_3	128.34 c	20.00 b	15.00	171.67	6.13 a	7.34 a
V_3×F_4	132.33 b	18.00 cd	15.00	165.00	5.83 b	6.56 bc
V_4×F_1	104.48 f	16.33 de	10.33	144.33	5.01 ef	6.47 bc
V_4×F_2	103.38 fg	16.00 e	11.33	157.33	5.33 cd	6.24 b-d
V_4×F_3	133.57 b	22.00 a	18.67	175.33	6.29 a	7.66 a
V_4×F_4	137.75 a	18.00 acd	15.33	169	5.75 b	6.70 b
S $\overline{X}$	1.18	0.59	0.77	3.54	0.09	0.16
Level of significance	**	**	NS	NS	**	**

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

obtained from the interaction between BRRI dhan31 and low level of fertilizer dose which was identical (4.00 t ha^{-1}) to the interaction between BRRI dhan30 and control treatment (Table 3). Straw yield was significantly influenced by the interaction between variety and fertilizer dose. The highest straw yield (7.66 t ha^{-1}) was achieved from the interaction between BRRI dhan41 and recommended level of fertilizer dose which was statistically identical (7.34 t ha^{-1}) to the combination of BRRI dhan40 and recommended level of fertilizer dose. The lowest straw yield (5.17 t ha^{-1}) was obtained from the interaction between BRRI dhan31 and low level of fertilizer dose (Table 3). It could be concluded that BRRI dhan41 grown with the recommended level of fertilizer dose emerged as a promising practice in order to get high yield performance. BRRI dhan41 appears to be the best variety in the transplant *Aman* season regarding grain and straw yields among the varieties studied.

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